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Patent Assignee: TOKYO SHIBAURA ELECTRIC CO
Author (Inventor): MOTAI TOMONOBU; SUZUKI KOHEI
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ACTIVE MATRIX TYPE DISPLAY DEVICE

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INVENTOR(s): MOTAI TOMONOBU
SUZUKI KOHEI
APPLICANT(s): TOSHIBA CORP [000307] (A Japanese Company or Corporation), JP (Japan)
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ABSTRACT

PURPOSE: To provide an active matrix type liquid crystal display device with which the reduction of the electric power consumption of a driver IC is possible.

CONSTITUTION: This active matrix type liquid crystal display device has pixel electrodes 2 which are arranged in a matrix form on a first substrate, scanning lines 3 which are arranged in the horizontal direction between these pixel electrodes 2, signal lines 4 which are arranged in the vertical direction between the pixel electrodes 2, memory elements 6 of a static type which are respectively arranged in the respective intersected parts of the scanning lines 3 and the signal lines 4 and hold the binary display signals from the signal lines 4 according to the scanning signals from the scanning lines 3, switching elements 7 which are connected at one-side terminals to the pixel electrodes 2 and at their other-side terminals to wirings 5 applying reference potential and are turned on and off by the signals held in these memory elements 6, a second substrate which is arranged to face the first substrate and is provided with counter electrodes 8 so as to face the pixel electrodes 2 and a liquid crystal layer 10 which is disposed between the first and second substrates.

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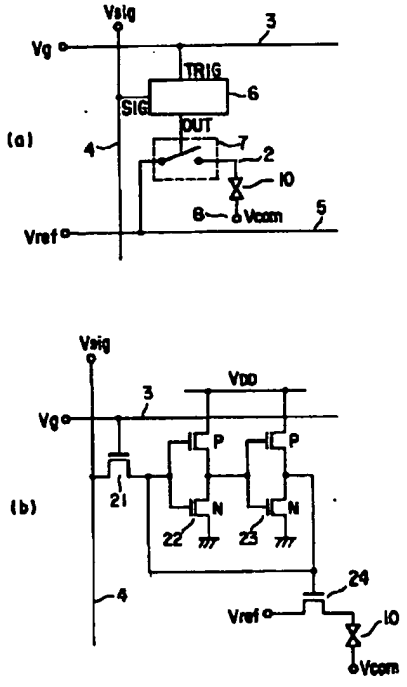
(71)出願人　000003078
株式会社東芝
神奈川県川崎市幸区堀川町72番地
(72)発明者　▲もたい▼　友信
神奈川県横浜市磯子区新磯子町33番地　株式会社東芝生産技術研究所内
(72)発明者　鈴木　公平
神奈川県横浜市磯子区新磯子町33番地　株式会社東芝生産技術研究所内
(74)代理人　弁理士　鈴江　武彦

(54)【発明の名称】　アクティブマトリックス型表示装置

(57)【要約】
【目的】　ドライバＩＣの消費電力を低減することのできるアクティブマトリックス型液晶表示装置を提供することにある。
【構成】　アクティブマトリックス型液晶表示装置において、第１の基板上にマトリックス状に配置された画素電極２と、画素電極２間に横列方向に配置された走査線３と、画素電極２間に縦列方向に配置された信号線４と、走査線３と信号線４の各交差部にそれぞれ配置され、走査線３からの走査信号に応じて信号線４からの２値表示信号を保持するスタティック型のメモリ素子６と、一方の端子が画素電極２に他方の端子が基準電位を与える配線５に接続され、メモリ素子６に保持された信号によりオン・オフするスイッチ素子７と、第１の基板と対向配置され、画素電極２と対向するように対向電極８が設けられた第２の基板と、第１及び第２の基板間に設けられた液晶層１０とを備えたことを特徴とする。



【特許請求の範囲】
【請求項１】第１の基板上にマトリックス状に配置された画素電極と、
第１の基板上に一方向に沿って配置された複数本の走査線と、
第１の基板上に前記走査線と交差する方向に配置された複数本の信号線と、
前記走査線と前記信号線との各交差部にそれぞれ配置され、前記走査線より入力された走査信号に応じて前記信号線より入力される２値表示信号を保持するスタティック型のメモリ素子と、
これらのメモリ素子に対応してそれぞれ設けられ、一方の端子が前記画素電極に接続され、他方の端子が基準電位を与える配線に接続され、前記メモリ素子に保持された信号により端子間をオン・オフするスイッチ素子と、
第１の基板と対向配置され、前記画素電極と対向するように対向電極が設けられた第２の基板と、
第１及び第２の基板間に設けられた表示材料層と、を具備してなることを特徴とするアクティブマトリックス型表示装置。
【請求項２】前記表示材料層は液晶であり、前記基準電位を与える配線及び対向電極の少なくとも一方に交流信号を印加することを特徴とする請求項１記載のアクティブマトリックス型表示装置。
【請求項３】基板上にマトリックス状に配置された画素電極と、前記基板上に一方向に沿って配置された複数本の走査線と、前記基板上に前記走査線と交差する方向に配置された複数本の信号線と、前記走査線と前記信号線との各交差部に配置され、前記走査線より入力された走査信号に応じて前記信号線より入力される表示信号を保持するメモリ素子と、これらのメモリ素子に対応してそれぞれ設けられ、一方の端子が前記画素電極に接続され、他方の端子が基準電位を与える配線に接続され、前記メモリ素子に保持された信号により端子間抵抗値が変化するスイッチ素子とを具備してなり、
前記画素電極が所定数毎にブロック化され、該ブロック内の画素電極の寸法がそれぞれ異なっていることを特徴とするアクティブマトリックス型表示装置。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明は、液晶ディスプレイなどの画像表示装置に係わり、特に薄膜トランジスタ等のスイッチ素子を用いたアクティブマトリックス型表示装置に関する。
【０００２】
【従来の技術】近年、液晶ディスプレイ等の薄型の表示装置の開発が活発に行われている。なかでも、どこでも持ち運べる携帯用や大画面の表示への要求が高まっており、軽量化，使用時間の長時間化，低消費電力化が求められている。このためには、電源用バッテリーの高性能化のほかに、表示装置自体の消費電力を下げる方法による効果が大きい。
【０００３】液晶表示装置では、背面照明として利用されている蛍光管，導光板，蛍光管用インバータの効率が低く、現状はこれら照明で消費される電力に対する高効率化による効果が大きいことから、表示材料或いは表示パネル自体の改良による消費電力低減の試みは殆どない。しかし、将来的には表示パネル自体の消費電力を低減することが必要と考えられる。
【０００４】表示パネル自体の消費電力は、おもにドライバＩＣ特性と表示パネルの駆動方法に依存すると考えられており、使用ドライバＩＣの低電圧化の改良が進められている。しかし、表示画素部にＴＦＴ（薄膜トランジスタ）等のスイッチ素子を設け、画像信号を短い周期で繰り返し書き込む方法（ＴＦＴ－ＬＣＤ）では、ドライバＩＣの個々の画素駆動を担当するトランジスタの消費電力を低減することは容易ではない。
【０００５】表示パネル自身の消費電力は、現状の１０インチクラスのＴＦＴ－ＬＣＤでは、回路系の消費電力が１．５Ｗ程度で、バックライト照明が５Ｗ程度であるが、電池動作を長時間化するためには１Ｗ未満、望ましくは小型軽量電池での駆動が可能な０．２Ｗ未満が要求されている。この消費電力の問題は、照明を伴う透過型表示装置よりも、照明を伴わない反射型表示装置で顕著となる。特に、広告用表示装置等に使用される対角５０センチ以上の表示装置では、消費電力量が設置場所の制約を生じさせていた。
【０００６】図１１（ａ）は、従来のアクティブマトリックス型液晶表示装置を示す回路構成図である。薄膜工程により、走査線７３，信号線７４，共通配線７５、３端子スイッチ素子の薄膜トランジスタ７７や画素部電極などが作成され、ドライバＩＣより走査信号と画像信号が、各々走査線７３と信号線７４に入力される。ここで、走査信号が入力された薄膜トランジスタ７７はオン状態となり、信号線７４からの画像信号が補助容量７８に蓄積されると共に液晶７９に伝達される。走査信号が入力されない場合には、薄膜トランジスタ７７はオフ状態となるため、オン時に印加された画像信号が液晶７９にそのまま保持される。
【０００７】このような構造の液晶表示装置では、書き込む信号がたとえ同一の画像であっても、液晶材料を交流駆動する必要上、再度、走査信号で薄膜トランジスタをオン状態にして、画像信号を再書き込みする必要が生じる。よって、駆動信号を発生させる走査信号用・画像信号用ドライバＩＣはたえず動作するので、電力は常に消費される。
【０００８】これに対して、図１１（ｂ）に示すように、第１のスイッチ素子Ｔ１により容量性負荷Ｃ１にアナログ信号を保持することで、第２のスイッチ素子Ｔ２を動作させる方法が提案されている（J.Vanfleteren（I

DRC,1988,p74-79))。しかし、表示画素のサイズが大きくなるにつれて、スイッチ素子Ｔ２及びこれにつながる容量負荷Ｃ２が大きくなるため、さらに保持したアナログデータに変動を生じさせないために、大容量の負荷容量Ｃ１を駆動する能力を持つスイッチ素子Ｔ１が必要となる。

【０００９】例えば、設計上のＣ１の容量値が過度に小さい場合には、Ｔ１がオンからオフとなった時のＴ２へ送ったオン信号のレベル減少や、Ｔ２がオン状態となる境界電圧であるしきい値電圧が経時変動することでＴ２のオン抵抗の上昇が発生し、目的とする表示が達成されない。加えて、Ｃ１等の大型化は消費電力の上昇を招くこととなる。これらの設計上の問題は、本素子構成がアナログ的なサンプルホールド回路よりなっているためであり、新構成の表示装置が求められていた。

【００１０】一方、アクティブマトリックス型液晶表示装置においては、面積変調によるデジタル階調表示を行う方法が提案されている。これは、画素電極を所定数毎にブロック化すると共に、ブロック内の各々の画素電極の寸法を変え、各ブロック内で表示すべき画素を選択することにより、各ブロックの表示画素面積をデジタル的に可変するものである。

【００１１】しかし、従来の駆動方法では、ＴＦＴなどのスイッチ素子が持つ寄生容量によって、スイッチング時に表示性能に悪影響を及ぼす画素電位のレベルシフトが発生する。このレベルシフト量は、寄生容量と画素電極容量とのスイッチングノイズ電荷の分配比で決定され、画素電極の寸法が異なるとレベルシフト量は画素電極毎に異なり、対向電極電位の調整によっても無害化することは困難である。従って、実質的に面積階調は不可能であった。

【００１２】

【発明が解決しようとする課題】このように従来、ドライバＩＣの消費電力の低減のために、液晶等の表示材料層に信号を供給するためのスイッチ素子を走査線で直接駆動するのではなく、アナログ的なサンプルホールド回路を用いて駆動する方法が提案されているが、この方法では十分な効果は達成できなかった。

【００１３】また、面積変調によるデジタル階調表示を行う例では、スイッチングノイズ電荷による画素電位のレベルシフトが発生し、このレベルシフト量は画素電極の寸法が異なると画素電極毎に異なり、対向電極電位の調整によっても無害化することは困難であり、従って実質的に面積階調は不可能であった。

【００１４】本発明は、上記事情を考慮してなされたもので、その目的とするところは、ドライバＩＣの消費電力を低減することのできるアクティブマトリックス型表示装置を提供することにある。

【００１５】また、本発明の他の目的は、ドライバＩＣの消費電力を低減することができ、かつ面積変調によるデジタル階調表示を可能としたアクティブマトリックス型表示装置を提供することにある。

【００１６】

【課題を解決するための手段】上記課題を解決するために、本発明は次のような構成を採用している。即ち、本発明（請求項１）は、マトリックス配置された各画素にスイッチ素子を設けたアクティブマトリックス型表示装置において、第１の基板上にマトリックス状に配置された画素電極と、第１の基板上に一方向に沿って配置された複数本の走査線と、第１の基板上に前記走査線と交差する方向に配置された複数本の信号線と、前記走査線と前記信号線との各交差部にそれぞれ配置され、走査線より入力された走査信号に応じて信号線より入力される２値表示信号を保持するスタティック型のメモリ素子と、これらのメモリ素子に対応してそれぞれ設けられ、一方の端子が前記画素電極に接続され、他方の端子が基準電位を与える配線に接続され、前記メモリ素子に保持された信号により端子間をオン・オフするスイッチ素子と、第１の基板と対向配置され、前記画素電極と対向するように対向電極が設けられた第２の基板と、第１及び第２の基板間に設けられた表示材料層とを具備してなることを特徴とする。

【００１７】ここで、本発明の望ましい実施態様としては、次のものがあげられる。

(1) 表示材料層は液晶であること。

(2) 走査線及び信号線は、画素電極間に配置されていること。

(3) 基準電位を与える配線及び対向電極の少なくとも一方に交流信号を印加すること。

(4) 同一走査線に接続されたメモリ素子が走査選択される時に、配線又は対向電極から印加される交流信号を一定電位とすること。

(5) ２値表示信号を保持するメモリ素子が不揮発性メモリにより形成されていること。

(6) メモリ素子及びスイッチ素子は、薄膜トランジスタにより形成されていること。

【００１８】また、本発明（請求項４）は、マトリックス配置された各画素にスイッチ素子を設けたアクティブマトリックス型表示装置において、基板上にマトリックス状に配置された画素電極と、前記基板上に一方向に沿って配置された複数本の走査線と、前記基板上に前記走査線と交差する方向に配置された複数本の信号線と、前記走査線と前記信号線との各交差部に配置され、走査線より入力された走査信号に応じて信号線より入力される表示信号を保持するメモリ素子と、これらのメモリ素子に対応してそれぞれ設けられ、一方の端子が前記画素電極に接続され、他方の端子が基準電位を与える配線に接続され、前記メモリ素子に保持された信号により端子間抵抗値が変化するスイッチ素子とを具備してなり、前記画素電極が所定数毎にブロック化され、該ブロック内の

画素電極の寸法がそれぞれ異なっていることを特徴とする。

(1) 表示材料層は液晶であること。

(2) 走査線及び信号線は、画素電極間に配置されていること。

(3) スイッチ素子は、オン・オフの２状態で動作し、複数の信号線と走査線をそれぞれ２状態の電位で駆動する駆動回路を備えていること。

(4) メモリ素子，スイッチ素子，駆動回路は、同一基板上に形成された薄膜トランジスタから構成されていること。

(5) メモリ素子を、応用システムの画像メモリとして用いること。

【００１９】

【作用】本発明（請求項１）によれば、１画素毎に設けられたスタティック型のメモリ素子によって、その画素で表示すべき情報が次に変化するまで周期的に書き換える必要なく、その状態が保たれる。表示画素の表示情報が変化しない場合には、メモリ素子への情報の書き換えは不要であるため、走査信号や画像信号を周期的に書き加える必要がなくなり、ドライバＩＣで消費される電力が低減される。

【００２０】即ち、従来装置では容量負荷の充放電に大部分の電力が消費されていたが、本発明では、従来のように表示画像が変化しなくても交流駆動のために信号線に一定周期の極性反転された信号を印加する必要がなく、信号線を駆動する駆動回路はほぼ停止状態のためそこで消費される電力は殆ど無視できるほど小さくなる。唯一消費される電力は対向電極の交流駆動によるものとなるが、これはフリッカが視認されない程度の例えば６０Ｈｚ以下の低い周波数で十分なため、消費電力は従来駆動法の１００分の１から１０００分の１程度にドラスティックに低減される。

【００２１】また、メモリ素子としてスタティック型を用いているので、大容量の負荷容量やこれを駆動する能力を持つ大きなスイッチ素子を必要とすることはなく、この点からも消費電力の低減に有効である。さらに、液晶表示装置の場合、従来ではスイッチ素子のオフ特性或いはフリッカ視認の制約から画素への信号書き替え周期を延ばすことが難しかったが、本発明の装置では、全表示画素の書き換え周期や１画素の書き換え時間を延長することが可能となる。

【００２２】また、本発明（請求項４）によれば、画素電極が所定数毎にブロック化され、そのブロック内の画素電極の寸法がそれぞれ異なっていることにより、１ブロックとして面積変調によるディジタル多階調表示が容易となる。従来の駆動法でこのように面積変調表示をしようとした場合、前述したようにスイッチングノイズ電荷による画素電位のレベルシフトが発生したが、本発明では、このスイッチングノイズ電荷によるレベルシフトは、液晶などの光電変換部材のリーク抵抗を通じてスイッチング終了後の初期に消滅する。このため、表示性能に悪影響を及ぼすことがなく、面積変調によるディジタル多階調表示が可能である。

【００２３】さらに、液晶などの光電変換部材の１画素の表示状態はオン又はオフの２状態であるため、中間調表示時でも視野角は広く、表示むらもない極めて良好な表示品位が得られる。

【００２４】

【実施例】以下、本発明の実施例を、公知の半導体技術を応用した薄膜工程で形成された薄膜トランジスタを利用して作成した液晶表示装置を例として説明する。

（実施例１）図１は、本発明の第１の実施例に係わるアクティブマトリックス型液晶表示装置の基本構成を示すもので、（ａ）は素子構造断面図、（ｂ）は回路構成図である。ガラス等からなる第１の基板１上に画素電極２がマトリックス状に配置されており、画素電極２間には紙面左右方向に走査線３が、上下方向に信号線４が配置されている。また、走査線３と平行に参照線５が配置されている。走査線３と信号線４の交差部に後述するメモリ素子６が設けられ、メモリ素子６と画素電極２間にはスイッチ素子７が設けられている。

【００２５】基板１上には所定距離離してガラス等からなる第２の基板９が対向配置されており、基板９の対向面には対向電極８が形成されている。そして、各基板１，９間に表示材料層としての液晶層１０が封入されている。なお、図中の１３は走査線ドライバ、１４は信号線ドライバ、１５は参照線ドライバである。

【００２６】図２（ａ）は、本実施例の１画素部構成を示す回路図である。マトリックス状に形成された走査線３と信号線４の交差部に２値データ保持メモリ素子６が接続されており、このメモリ素子６には、保持されている情報を出力する出力部が設けられている。出力部には、３端子スイッチ素子７の制御端子が接続されている。このスイッチ素子７は、参照線５と画素電極２との間の抵抗値を制御し、液晶層１０のバイアス状態を調整している。

【００２７】図２（ａ）におけるメモリ素子の例として、２段インバータを用い正帰還させた形のメモリ回路、即ちスタティック型メモリ素子が考えられる。本回路では、トランジスタのオフ特性が十分でなくアナログ信号用素子として利用不可能なトランジスタ素子で実現ができる特徴を持つ。

【００２８】具体的な回路構成を、図２（ｂ）に示す。前記図１１（ｂ）と比較して、容量Ｃ１が不要であるため、図１１（ｂ）の素子Ｔ１に対応する図２の素子２１は小さくてもよい。スイッチ素子２１とインバータ回路部２２，２３の各素子サイズは、インバータ回路部の最適段数比ｎと同様な考え方で設計可能である。具体的には、素子２１，２２，２３，２４の素子サイズの比が、

１：ｎ：ｎ：ｎ＊ｎで規定した場合にはｎ＝１～１００、願わくばｎ＝２～１０が良好な設計条件である。

【００２９】図３（ａ）（ｂ）及び図４（ａ）（ｂ）にその他のメモリ素子を使用した１画素部の回路構成例を示す。図３（ａ）と（ｂ）、図４（ａ）と（ｂ）は、それぞれ３端子スイッチ素子の接続位置が異なる構成例を示している。従来構造より表示画素の構成する素子数が増加するため、透過型の表示素子では光利用効率が減少するが、反射型の液晶表示装置では反射電極下にメモリ素子などを形成できるため本表示素子による光利用効率の低下は生じない。

【００３０】駆動波形は、図５のように従来の液晶表示装置の駆動のように線順次駆動となる。走査線３に順次走査パルスを印加し、これに同期させたメモリ素子６にスイッチ素子７の開閉を制御する信号を信号線４を通して入力する。一方、共通電極（対向電極８）には交流信号を入力する。上述の通り、液晶材料の抵抗値とスイッチ素子の抵抗値の比の条件が満足されれば、上記回路・駆動で良好な表示が可能となる。

【００３１】本装置は理想上、静止画像のように表示画像に変化がなくなれば、メモリ素子６へのリフレッシュは不要である。しかし、図５のように、単純な矩形波入力による駆動では、スイッチがオン状態からオフ状態へ切り替わる時にスイッチ側の液晶電位が、交流駆動信号の高い電位か低い電位かのどちらかの電位状態に固定化されるので、液晶部に直流電圧成分が加わることとなる。よって、表示性能を向上するためには、スイッチがオフ状態へ切り替わるときの液晶電位設定のための、リフレッシュ期間を設ける必要が生じる。

【００３２】最も簡単な方法として、図６（ａ）のように、共通電極の交流信号の間にブランキング期間を設ける方法がある。従来型のデバイスでは、図１１（ａ）の液晶７９やスイッチ素子７７のリーク電流による電位低下を保証する容量７８を液晶容量に並列接続しているために、信号の書き込み時間を短縮することが容易でなかった。本発明の素子では、図２（ｂ）のように、スイッチ素子２１のゲート開閉のための信号を送るのみであるために、リフレッシュの時間は従来型の素子に見られる走査時間よりも短くて済む。

【００３３】また、図６（ｂ）のように、全画素を連続的にリフレッシュせず、リフレッシュするラインの時間を分割し、矩形信号である液晶駆動信号間に挿入することも可能である。挿入法は、一定時間で見た場合に全ライン上のメモリがリフレッシュされることが望ましいが、走査ラインの一定位置で、表示画面が変化する場合、例えば点滅表示部分が固定位置である場合には、該当する表示ラインに重みを付けてリフレッシュすることも可能である。

【００３４】なお、図６（ｂ）において、Ｔｇはリフレッシュパルス幅、Ｉは１回のリフレッシュライン数であり、１画面書き替えのためのリフレッシュ回数は、（ゲートライン数）／Ｉで定義される。

【００３５】このように本実施例によれば、１画素毎にスタティック型のメモリ素子６を設け、この素子６の記憶情報でスイッチ素子７を駆動するようにしているので、表示情報が変化しない場合には、メモリ素子７への情報の書き換えは不要である。このため、走査信号や画像信号を周期的に書き加える必要がなくなり、ドライバＩＣで消費される電力が大幅に低減される。

【００３６】また、メモリ素子６がスタティック型であることから、前記図１１（ｂ）に示した従来のように、大容量の負荷容量Ｃ１やこれを駆動する能力を持つ大きなスイッチ素子Ｔ１を必要とすることはなく、この点からも消費電力の低減に有効である。さらに、本実施例では、スイッチ素子のオフ特性或いはフリッカ視認の制約が抑制され、全表示画素の書き換え周期や１画素の書き換え時間を延長することが可能となる。

【００３７】本実施例において、アモルファスシリコン薄膜を使用した１０インチクラスのＴＦＴ－ＬＣＤでの消費電力試算は、表示画面を書換えない状態で１０ｍＷ、毎秒一画面の書換え状態としても３０ｍＷ未満と、従来と比較して、５０分の１の大幅な低消費電力化が実現できた。

（実施例２）図７は、本発明の第２の実施例に係わるアクティブマトリックス型液晶表示装置を説明するためのもので、（ａ）は１画素部構成を示す回路図、（ｂ）はメモリ素子の構造断面図である。

【００３８】本実施例は、基本的には第１の実施例と同様であるが、図７（ａ）に示すように、メモリ素子３０として書換可能な不揮発性メモリを用いている。メモリ素子３０の具体的構成は図７（ｂ）に示す通りであり、通常の逆スタガー型ＴＦＴのゲートを２層構造としたものである。図中の３１は基板、３２は第１ゲート（制御ゲート）、３３はゲート絶縁膜、３４は第２ゲート（浮遊ゲート）、３５はトンネル絶縁膜、３６はａ－Ｓｉ等の活性層、３７は保護絶縁膜、３８ａ，３８ｂはソース・ドレイン電極である。

【００３９】書換の回数は、従来駆動のスイッチング回数の目安である10^7回以上の書き換え動作を満足することが理想であるが、静止画表示が主体となる表示装置であるならば、書き換え回数は１００～１００００分の１に減少させることが可能で本表示装置のメモリ素子として利用できる。上述のメモリ素子は、ＥＥＰＲＯＭ構成となっているが、誘電体材料の電場－誘電率カーブ（Ｄ－Ｅカーブ）が、ヒステリシスを特性を有する材料で構成される場合も同様の表示装置が構成可能である。

【００４０】具体的には、図８に示すように、ヒステリシスを有する誘電体材料をゲート絶縁膜として利用することでメモリ素子を作成し、メモリ素子に加える端子間電圧を制御することで、メモリ素子のリセット、メモリ

の信号書き込みを行う。図のように、メモリ素子に薄膜トランジスタ７を接続する方法に加えて、直接表示電極にメモリ素子の接続も駆動信号の改良により可能である。

（実施例３）第１の実施例では、Ｖcom （共通電極８）のみに交流信号を入力して液晶材料を駆動しているが、交流信号はＶref （参照線５）側に入力してもよい。Ｖrefに交流信号を入力した場合、液晶層１０を介して参照線５と共通電極８との結合容量による共通電極電位の変動が観測される。この変動の対策としては、参照線５毎に駆動信号の符号を反転させた信号を利用する方法があり、さらに交流駆動信号の周期を走査時間毎にすることも可能である。

【００４１】一方、交流信号をＶcom とＶref の両方に入力し、駆動することも可能であり、駆動信号用ドライバＩＣの低電圧化が可能となる。この駆動は、Ｖcom のみを交流駆動した場合と比較して、ドライバＩＣの出力端子１個に流れる電流量あるいは、出力される電圧が低くなり、ドライバＩＣが消費する電力を下げることが可能となる。

【００４２】各実施例におけるメモリ素子の活性層を構成する材料としては、単結晶シリコン，多結晶シリコン，アモルファスシリコンが考えられるが、特に本構造の表示素子は、３端子スイッチ素子の動作が可能な素子であれば、開閉時の抵抗値の比が10^5倍程度であることが望ましいが、最低で１００倍程度であっても実施が可能と考える。これは、活性層を有機材料や１５０℃程度の低い温度、或いはそれ以下で成膜されたアモルファスシリコンなどの使用も考えられるようになり、各材料のプロセス上の制約、素子構造上の制約が緩和される。

【００４３】また、フォトリングラフィー工程を減らした素子などで、従来では表示素子として不十分なスイッチ特性の素子であっても、さらに高いコントラスト表示が得られる。また、図２（ｂ）中の素子２４を各種アニール等の方法で性能向上することでサイズの小型化を実現できる。一方、表示材料の液晶においても、電気光学的な材料特性が、通常使用範囲で経時劣化しないのであれば、フリッカが視認されにくい長周期側の交流信号（～１０秒）に設定することも可能である。

（実施例４）メモリ素子のリフレッシュをする方法は、上述の通り表示画面に変化が発生しているラインに重み付けをすることで、他の静止画表示部分の消費電力を抑えることが実現できた。本駆動方法は、従来の線順次駆動（走査配線を順次走査する駆動法）の改良で駆動部分を構成できるが、認識された動画部分に対応した走査配線をスキャンすることが必要となる。動画部分を正確に認識し、動画部のみの信号情報を書き換えることは、単純に走査配線数を減少させる効果から低消費電力化となるが、駆動ＩＣの構成が複雑となり、かえって消費電力の上昇を招くことになる。

【００４４】そこで、動画表示部の指定ライン数をブロック化することで、トータルの駆動ＩＣの消費電力の低減がはかれる。ブロック化するライン数としては、１０～２００、望ましくは５０～１００の走査線数がよい。ブロック化したラインの指定方法は、画像信号の入力部に画像メモリを設け動画部分を検出し、検出した走査ライン部のブロック位置と信号を駆動ＩＣへ出力する。この出力をもとに、動画表示部分に対応したメモリ素子への信号供給を行う。

【００４５】外部に画像メモリを有することは、該当するメモリの消費電力が本表示素子の消費電力に較べ低減されなければならない。理想では、表示画素毎に画像メモリを持つ必要があるが、例えば同一走査ラインの表示信号を一定周期或いは順次全てサンプリングして、２値情報をカウントした後、記憶してある前カウントデータとの比較を行うことで、簡易に動画を検出することができる。

【００４６】この方法では、表示画素がオン状態の総数が同じであった場合には、動画表示であっても認識することができないが、上述の方法に加えて、ブロック化した走査ライン部のメモリデータの合計を使用しての比較により、動画認識の誤差は大幅に減少可能となる。一方、本カウンタ方式で問題となるのは、サンプリング部とカウンタ部で発生するカウントミスである。カウントミスが多い場合には、全てを動画と認識してしまうために本構成回路の効果が期待できない。そこで、比較時に予めカウント誤差を考慮することで、本問題を解決できる。

【００４７】画像メモリと同メモリ情報から動画の情報を得る動画検出部の構成を簡略化する方法としては、表示装置に半固定的な表示の重み付けをする方法も考えられる。具体的には、パソコン等のソフトウエアの多くは、表示画面の周辺部に選択用或いは機能表示の画面を有することが多い。この選択用の画面表示の多くは、変化することが多くない。このような場合、代表的なソフトウエアに対しては、予め動画表示が多くない領域が分かっているので、その領域に対する走査信号のリフレッシュの重み付けを下げることが可能となる。

【００４８】個別のソフトウエアに関しても、静止画である確率が高い表示領域が存在する場合には、ユーザがその領域を指定することで重み付けすることも可能となる。ＰＤＡ等の操作画面がある程度予測可能な機器に関しては、表示装置側に画面のリフレッシュする重み付けを予め幾つか用意しておき、ＤＩＰ－ＳＷ等のスイッチで指定する方法も可能である。

【００４９】また、測定機器等の操作画面等においても、頻繁に画面の表示状態が変化する領域は、測定結果を表示する部分や操作案内をするメニューの部分が主となる。加えて、これら計測器などは、ユーザが操作パネルを操作しない場合は、測定結果の表示のみが変化する

ことが予め分かっているため、測定結果表示の部分に対応した画面を走査してメモリ素子への信号供給を行えばよいことになる。

【００５０】この場合も、表示装置側での設定で対応できる。さらに細かくは、動画表示で走査されるライン数が少なければ、本装置の効果が高くなるので、動画表示部分が特定の連続した走査ライン上に集中するように、動画表示の画面をレイアウトすればよい。

（実施例５）図９は本発明の第５の実施例に係わるアクティブマトリックス型液晶表示装置の１ブロックの概略回路構成図である。

【００５１】ここでは、４ビット１６階調表示の場合である。表示装置全体の画素ブロック数をＭ×Ｎ個としたときのｉｊ番目のブロック（ｉは１～Ｍ、ｊは１～Ｎ）について示している。パソコンで現在主流のＶＧＡ規格の表示の場合、Ｍ＝６４０，Ｎ＝４８０となる。

【００５２】画面Ｘ方向のアドレス線ＡＤＲＳ－Ｘｉと画面Ｙ方向のアドレス線ＡＤＲＳ－Ｙｉとの交点にＡＮＤゲートＧｉｊが設けられ、その出力と４本の画像データ線Ｄ０～Ｄ３の各々の交点にＡＮＤゲートＧ０ｉｊ～Ｇ３ｉｊが設けられている。ＡＮＤゲートＧ０ｉｊ～Ｇ３ｉｊの出力はメモリ素子Ｍ０ｉｊ～Ｍ３ｉｊに接続され、メモリ素子Ｍ０ｉｊ～Ｍ３ｉｊの出力はスイッチングトランジスタＴ０ｉｊ～Ｔ３ｉｊのゲート電極に接続され、スイッチングトランジスタＴ０ｉｊ～Ｔ３ｉｊのオンオフを制御する。スイッチングトランジスタＴ０ｉｊ～Ｔ３ｉｊのソース又はドレイン電極の一方は第１の共通電位線ＣＯＭ１に、他方は画素電極を介して画素の液晶Ｐ０ｉｊ～Ｐ３ｉｊに接続されている。

【００５３】なお、本実施例のメモリ素子は第１の実施例で用いたようなスタティック型に限らず、ダイナミック型でもよいし、さらにＥＥＰＲＯＭでもよく、各種の方式を利用することができる。

【００５４】画素電極の面積はそれぞれ異なり、図１０に示すように、Ｐ０に対応した画素電極の面積を１とするとＰ１は２倍、Ｐ２は４倍、Ｐ３は８倍になっている。画素の液晶Ｐ０ｉｊ～Ｐ３ｉｊの他端は共通電極である第２の共通電位線ＣＯＭ２に接続されている。第１の共通電位線ＣＯＭ１と第２の共通電位線ＣＯＭ２の間には交流の液晶駆動電源ＤＲＶが接続されている。

【００５５】本実施例の動作は次のようになる。４ビットの画像データは、画面Ｘ方向のアドレス線ＡＤＲＳ－Ｘｉと画面Ｙ方向のアドレス線ＡＤＲＳ－Ｙｊが共にアクティブの時メモリ素子Ｍ０ｉｊ～Ｍ３ｉｊに記憶され、次に再び選択されるまでその状態を保持し続ける。対向電極には、用いた液晶の駆動に必要な一定の交流電圧（例えば現在一般に使われているＴＮ液晶では±５Ｖの１０Ｖ振幅の電圧）が印加されるが、この１画素毎に設けられたメモリ回路Ｍ０ｉｊ～Ｍ３ｉｊによって制限されるスイッチングトランジスタＴ０ｉｊ～Ｔ３ｉｊによって、画素の液晶Ｐ０ｉｊ～Ｐ３ｉｊには上記駆動電圧が印加されるか印加されないかが制御され、所望の表示状態が維持される。

【００５６】従来のアクティブマトリクス液晶表示装置では、データ線駆動回路や制御回路の内部等価容量やデータ線配線容量負荷の充放電、対向電極容量の高速充放電のなどに大部分の電力が消費されていたが、本実施例では、従来のように表示画像が変化しなくても交流駆動のためにデータ線に一定周期の極性反転された信号を印加する必要がなく、データ線駆動回路や制御回路はほぼ停止状態のため、そこで消費される電力は殆ど無視できるほど小さくなる。唯一消費される電力は対向電極の直流駆動によるものとなるが、これはフリッカが視認されない程度の例えば６０Ｈｚ以下の低い周波数で十分なため、消費電力は従来駆動法の１００分の１から１０００分の１程度に低減される。

【００５７】この理由を、以下に説明する。対向電極全体の容量Ｃcom は、電極面積Ｓと液晶の誘電率ε、ギャップｄでほぼ決定され、Ｃcom ＝εＳ／ｄとなり、１０インチクラスの液晶表示装置の場合その容量は０．１～０．３μＦ程度である。この容量を周波数ｆdrv 、電圧Ｖdrv の交流電圧で充放電させるに消費される電力Ｐcom は、Ｐcom ＝Ｃcom ・ｆdrv ・$Vdrv^2$ で与えられ、±５Ｖで６０Ｈｚで駆動した場合には０．１５ｍＷ～０．４５ｍＷと非常に小さいものになる。実際には、液晶のリーク抵抗やメモリ回路や駆動回路内のリーク電流による電力消費がそれに加算されるが、全体としての消費電力はそれでも１ｍＷから数１０ｍＷ程度に小さく抑えられる。

【００５８】さらに、画素電極が所定数毎にブロック化され、そのブロック内の画素電極の寸法がそれぞれ異なっていることにより、１ブロックとして面積変調によるディジタル多階調表示が容易となる。従来の駆動法でこのような面積変調表示をしようとしたときの以下の問題が発生せず、極めて高画質の表示品位が得られる。

【００５９】従来駆動では、ＴＦＴなどのスイッチ素子が持つ寄生容量によってスイッチング時に、表示性能に悪影響を及ぼす画素電位のレベルシフトが発生するが、このレベルシフト量は上記寄生容量と画素電極容量とのスイッチングノイズ電荷の分配比で決定され、画素電極の寸法が異なるとレベルシフト量は画素電極毎に異なり対向電極電位の調整によっても無害化することが困難であり、実質的に面積階調は不可能であった。

【００６０】本実施例では、このスイッチングノイズ電荷によるレベルシフトは、液晶のリーク抵抗を通じてスイッチング終了後の初期に消滅するため、表示性能に悪影響を及ぼすことがなく、面積変調によるディジタル多階調表示が可能である。また、この方法では液晶の１画素の表示状態ではオン又はオフの２状態であるため、中間調表示時でも視野角は広く、表示むらやフリッカもな

い極めて良好な表示品位が得られる。

【００６１】なお、本発明は上述した各実施例に限定されるものではない。実施例では、表示材料層として液晶を用いたが、これに限らず他の材料を用いることができる。例えば、ＥＬやプラズマディスプレイ等に適用することが可能である。また、液晶の場合は、反射型に限らず透過型に適用することも可能である。その他、本発明の要旨を逸脱しない範囲で、種々変形して実施することができる。

【００６２】

【発明の効果】以上詳述したように本発明によれば、１画素毎にスイッチ素子を制御するためのスタティック型のメモリ素子を設けているので、走査信号や画像信号を周期的に書き加える必要がなくなり、ドライバＩＣで消費される電力を低減することができる。従って、従来型の電源装置の小型化、或いは充電型電源装置の使用時間延長を可能とする。

【００６３】また本発明によれば、所定数の画素毎にブロック化して階調表示を行う方式において、１画素毎にスイッチ素子を制御するためのメモリ素子を設けているので、スイッチングノイズ電荷によるレベルシフトを抑制することができ、ドライバＩＣの消費電力を低減することができ、かつ面積変調によるデジタル階調表示を行うことが可能となる。

【図面の簡単な説明】

【図１】第１の実施例に係わるアクティブマトリックス型液晶表示装置の基本構成を示す素子構造断面図と回路構成図。

【図２】第１の実施例の１画素部構成を示す回路構成図。

【図３】第１の実施例の変形例を示す回路構成図。

【図４】第１の実施例の変形例を示す回路構成図。

【図５】第１の実施例における駆動信号の一例を示す図。

【図６】第１の実施例における駆動信号の他の例を示す図。

【図７】第２の実施例に係わるアクティブマトリックス型液晶表示装置の１画素部構成を示す回路図とメモリ素子の構造断面図。

【図８】第２の実施例における駆動信号の一例を示す図。

【図９】第５の実施例に係わるアクティブマトリックス型液晶表示装置の１ブロックの概略回路構成図。

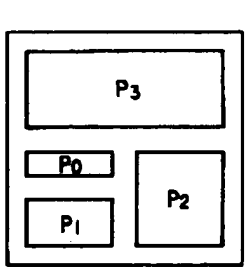
【図１０】１ブロックにおける画素の大きさ及び配置例を示す図。

【図１１】従来のアクティブマトリックス型液晶表示装置を示す回路構成図。

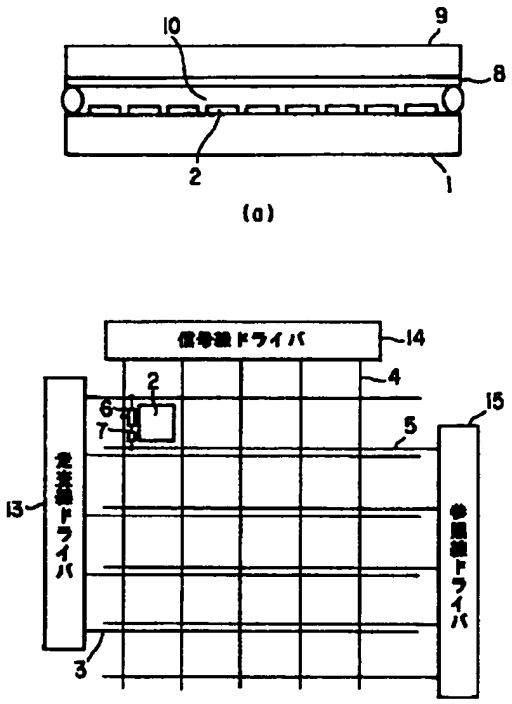
【符号の説明】

１…第１の基板
２…画素電極
３…走査線
４…信号線
５…参照線
６…メモリ素子
７…スイッチ素子
８…対向電極
９…第２のガラス基板
１０…液晶層（表示材料層）
２１…スイッチ素子
２２，２３…インバータ素子
２４…スイッチ素子

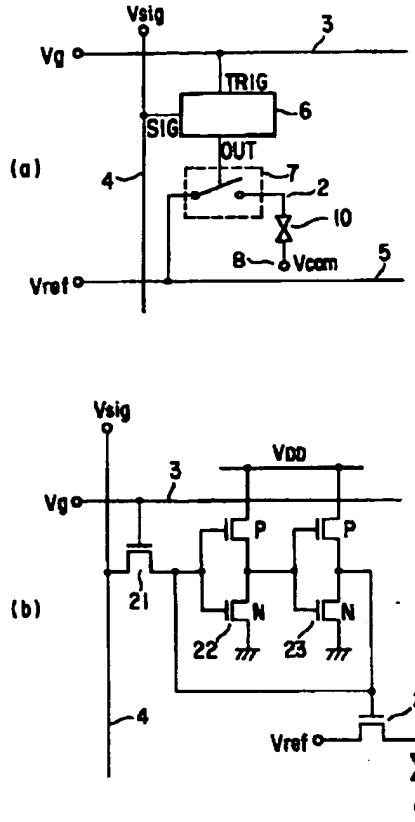
【図１０】



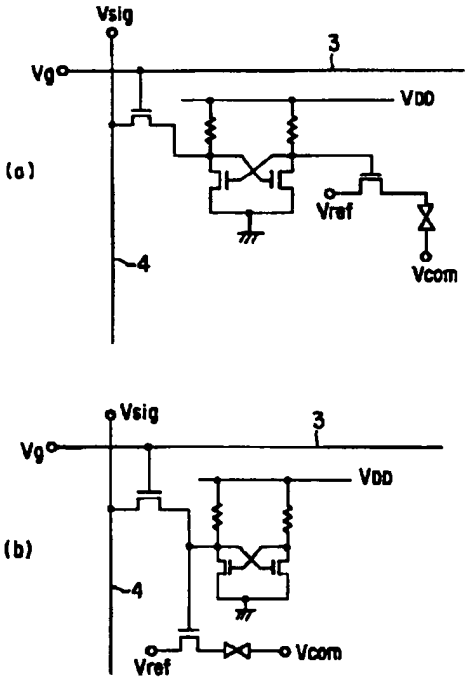
【図1】


10
9
8
2
1
(a)
信号線ドライバ
14
4
2
6
7
5
15
13
走査線ドライバ
3
(b)

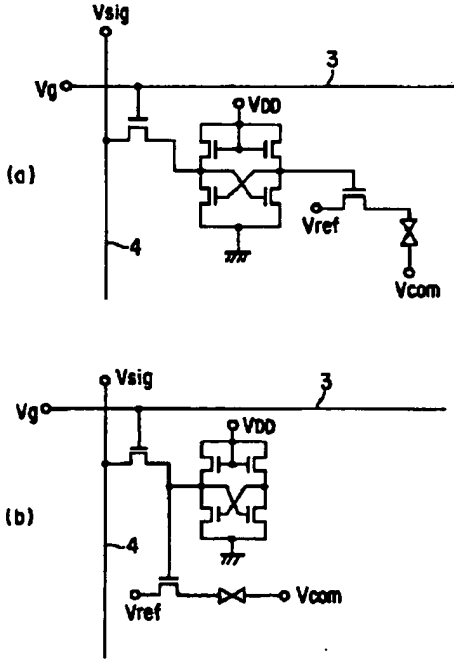
【図2】


Vsig
3
Vg
TRIG
6
SIG
OUT
(a)
4
7
2
10
8
Vcom
5
Vref
Vsig
Vg
3
VDD
P
P
(b)
21
N
N
22
23
24
4
Vref
10
Vcom

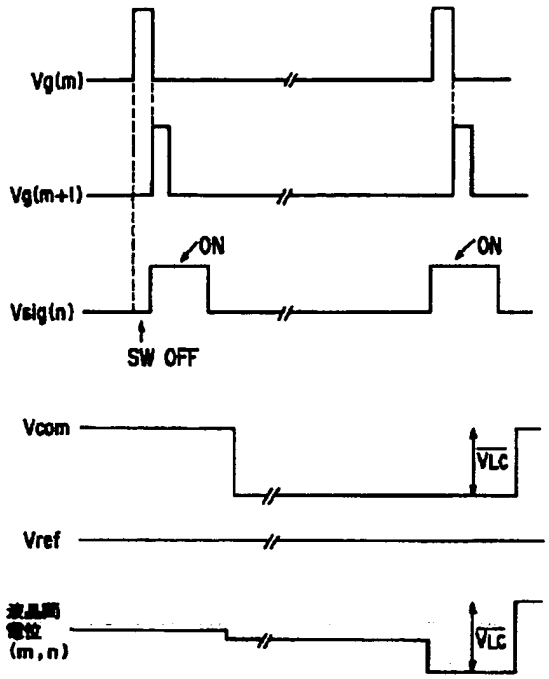
【図3】


Vsig
3
Vg
VDD
(a)
Vref
4
Vcom
Vsig
3
Vg
VDD
(b)
4
Vref
Vcom

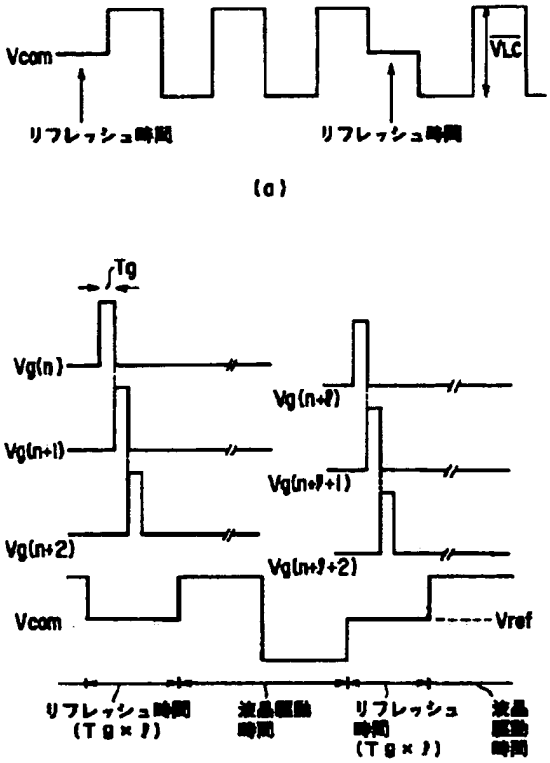
【図4】


Vsig
3
Vg
VDD
(a)
Vref
4
Vcom
Vsig
3
Vg
VDD
(b)
4
Vref
Vcom

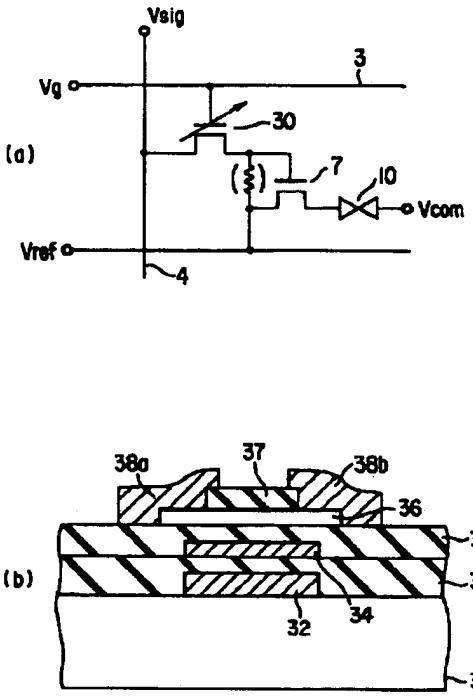
【図5】


Vg(m)
Vg(m+1)
ON
ON
Vsig(n)
SW OFF
Vcom
VLC
Vref
液晶印加電位 (m,n)
VLC

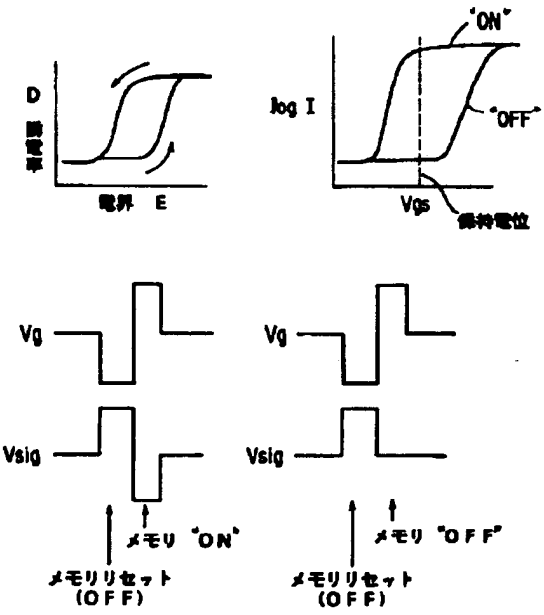
【図6】


Vcom
VLC
リフレッシュ時間
リフレッシュ時間
(a)
Tg
Vg(n)
Vg(n+1)
Vg(n+2)
Vg(n+j)
Vg(n+j+1)
Vg(n+j+2)
Vcom
Vref
リフレッシュ時間 (Tg×j)
液晶駆動時間
リフレッシュ時間 (Tg×j)
液晶駆動時間
(b)

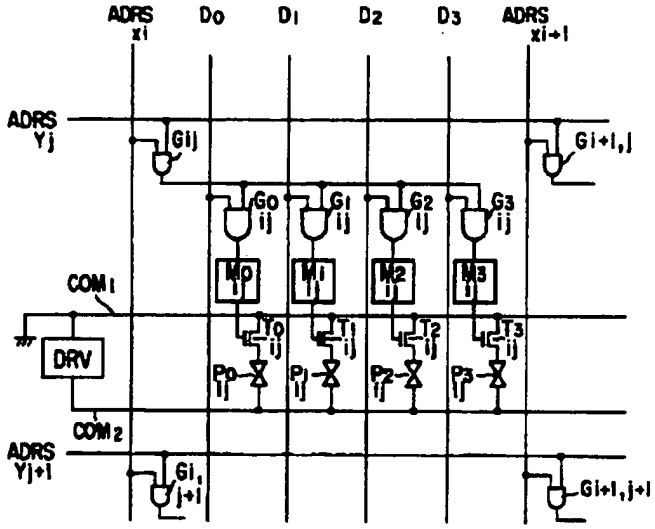
【図7】


Vsig
Vg
3
30
(a)
7
10
Vcom
Vref
4
38a
37
38b
36
35
(b)
33
34
32
31

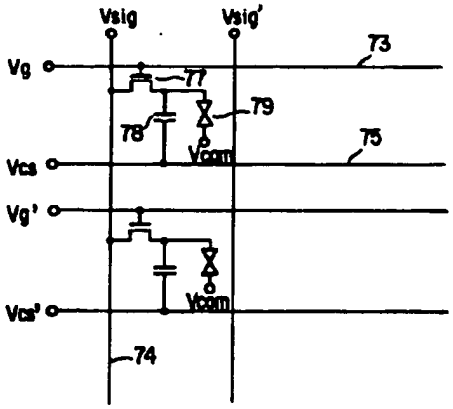
【図8】


D
電界 E
log I
"ON"
"OFF"
Vgs
保持電位
Vg
Vsig
メモリ "ON"
メモリリセット (OFF)
Vg
Vsig
メモリ "OFF"
メモリリセット (OFF)

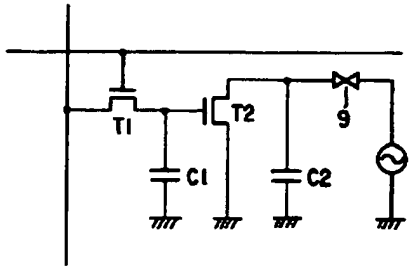
【図９】


ADRS xi
Do
D1
D2
D3
ADRS xi+1
ADRS Yj
Gij
Gi+1,j
Go ij
G1 ij
G2 ij
G3 ij
Mo ij
M1 ij
M2 ij
M3 ij
COM1
DRV
To ij
T1 ij
T2 ij
T3 ij
Po ij
P1 ij
P2 ij
P3 ij
COM2
ADRS Yj+1
Gi, j+1
Gi+1,j+1

【図１１】


Vsig
Vsig'
Vg
Vcs
Vg'
Vcs'
T3
T7
T9
T8
Vcom
T5
Vcom
T4

(a)


T1
T2
9
C1
C2

(b)

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim]
[Claim 1] The pixel electrode arranged in the shape of a matrix on the 1st substrate, and two or more scanning lines arranged along with ** on the other hand on the 1st substrate, Two or more signal lines arranged in the orientation which crosses with the aforementioned scanning line on the 1st substrate, The static type memory device holding the binary status signal inputted from the aforementioned signal line according to the scanning signal which has been arranged, respectively and was inputted into each intersection of the aforementioned scanning line and the aforementioned signal line from the aforementioned scanning line, The switching device which turns between terminals on and off with the signal which it was prepared corresponding to these memory devices, respectively, and one terminal was connected to the aforementioned pixel electrode, was connected to the wiring whose other-end child gives a reference potential, and was held at the aforementioned memory device, Active matrix type display which opposite arrangement is carried out with the 1st substrate, and is characterized by coming to provide the display material layer prepared between the 2nd substrate in which the counterelectrode was prepared so that it might counter with the aforementioned pixel electrode, and the 1st and 2nd substrates.
[Claim 2] The aforementioned display material layer is the active matrix type display of the claim 1 publication characterized by impressing an alternating current signal to either [at least] the wiring which is liquid crystal and gives the aforementioned reference potential, or a counterelectrode.
[Claim 3] The pixel electrode arranged in the shape of a matrix on a substrate, and two or more scanning lines arranged along with ** on the other hand on the aforementioned substrate, Two or more signal lines arranged in the orientation which crosses with the aforementioned scanning line on the aforementioned substrate, The memory device holding the status signal inputted from the aforementioned signal line according to the scanning signal which has been arranged at each intersection of the aforementioned scanning line and the aforementioned signal line, and was inputted from the aforementioned scanning line, Corresponding to these memory devices, it is prepared, respectively, and one terminal is connected to the aforementioned pixel electrode. It comes to provide the switching device from which the resistance between terminals changes with the signals which were connected to the wiring whose other-end child gives a reference potential, and were held at the aforementioned memory device. Active matrix type display characterized by blocking the aforementioned pixel electrode for every predetermined number, and the dimensions of the pixel electrode within this block differing, respectively.

[Translation done.]

* NOTICES *

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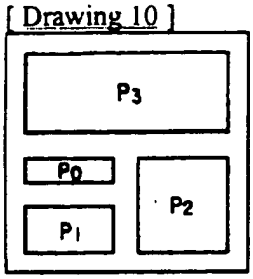
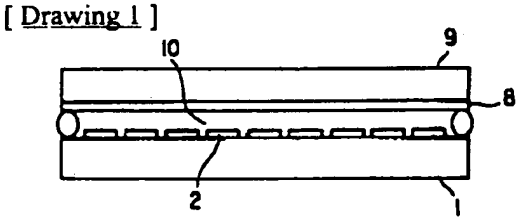
DRAWINGS

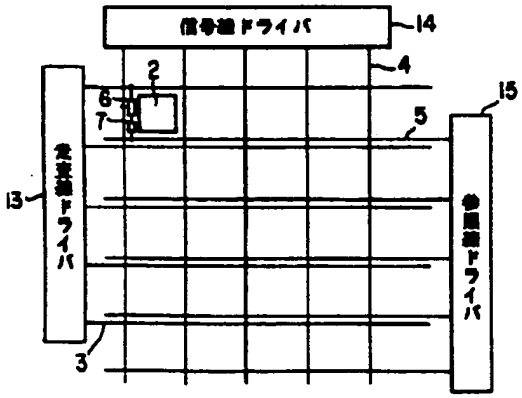
[Drawing 10]



[Drawing 1]

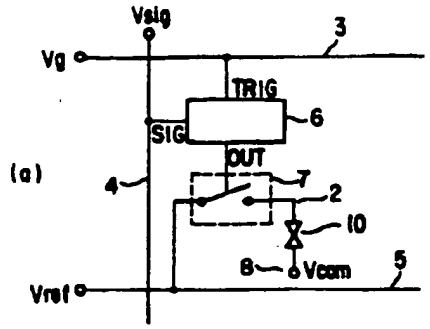


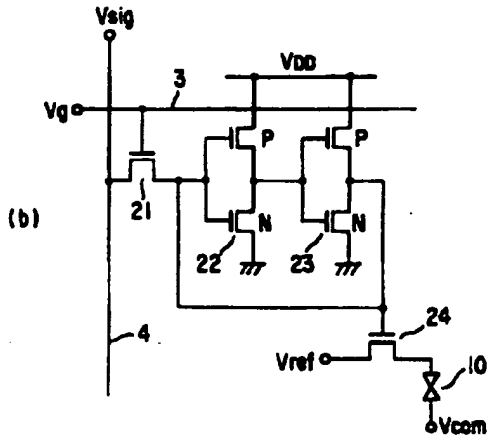
(a)



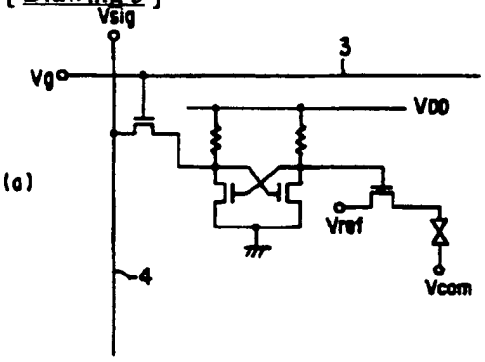
(b)

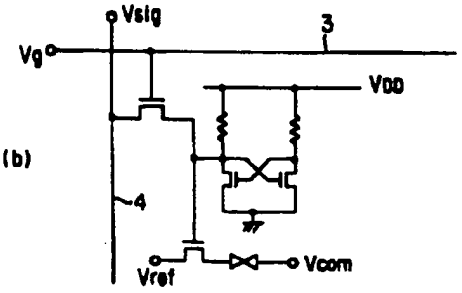
[Drawing 2]


Vsig
3
Vg
TRIG
6
SIG
OUT
7
(a)
4
2
10
8
Vcom
5
Vref

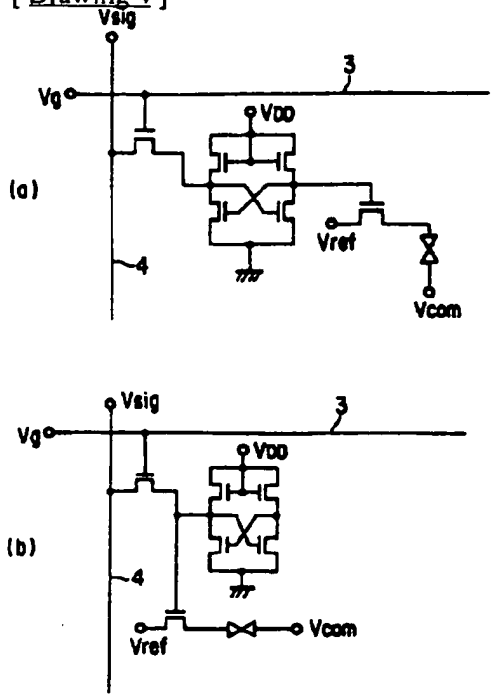

Vsig
VDD
3
Vg
P
P
21
(b)
N
N
22
23
24
4
Vref
10
Vcom

[Drawing 3]

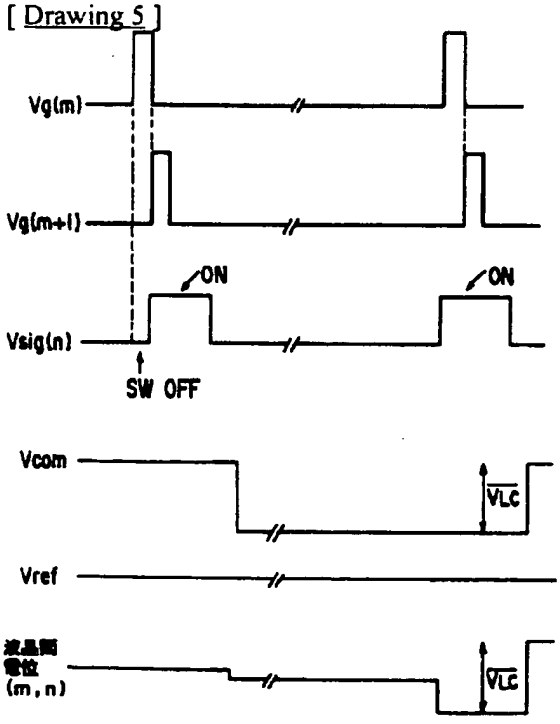

Vsig
3
Vg
VDD
(a)
Vref
4
Vcom


Vsig
3
Vg
VDD
(b)
4
Vref
Vcom

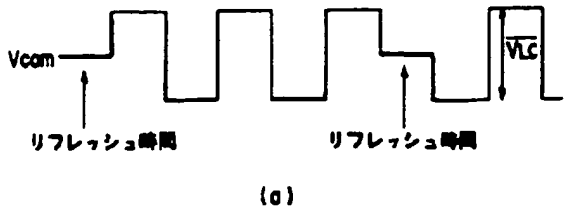
[Drawing 4]



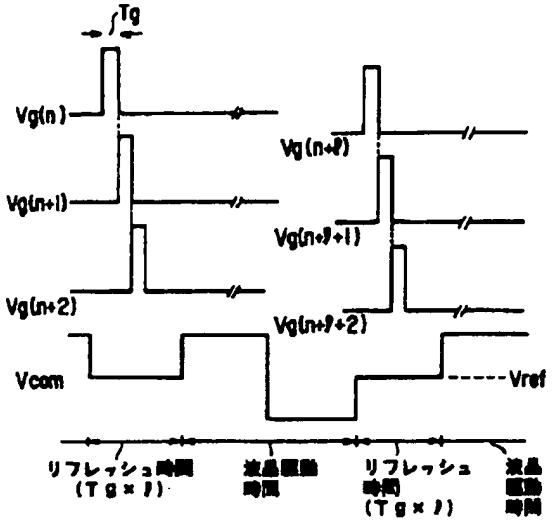
[Drawing 5]



[Drawing 6]

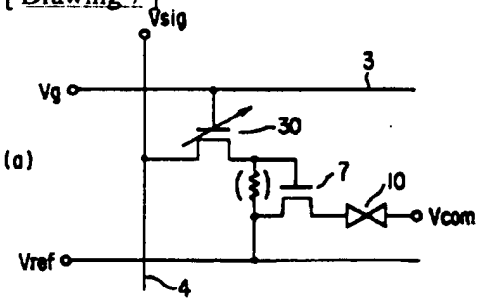


(a)

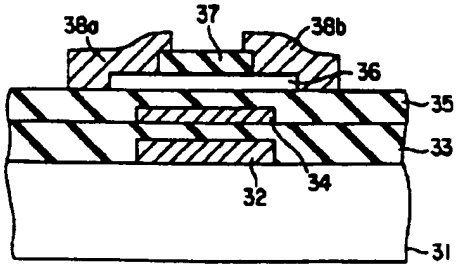


(b)

[Drawing 7]

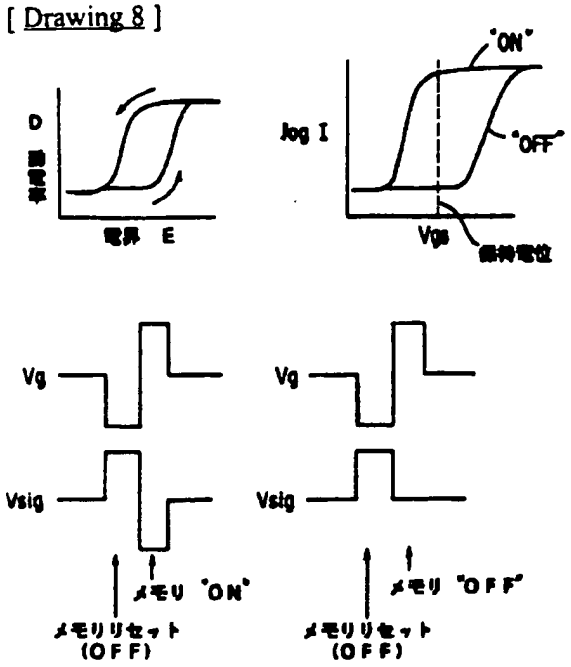


(a)

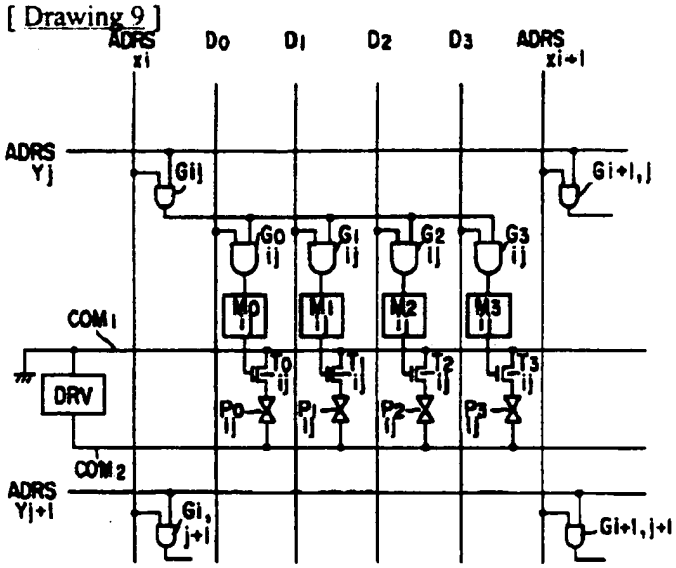


(b)

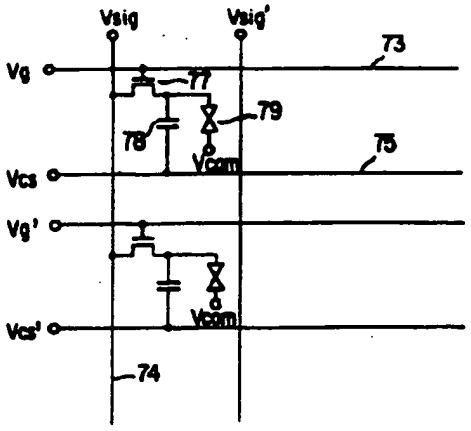
[Drawing 8]



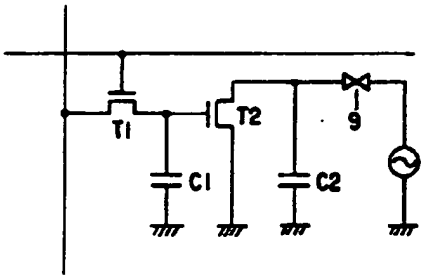
[Drawing 9]



[Drawing 11]



(a)



(b)

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed description]
[0001]
[Field of the Invention] Especially this invention relates to the active matrix type display using switching devices, such as TFT, with respect to image display equipments, such as a liquid crystal display.
[0002]
[Prior art] In recent years, the development of the display of thin shapes, such as a liquid crystal display, is performed actively. Especially the demand to a display of portable [which can be carried anywhere], or a big screen is increasing, and it is asked for long-time-izing of lightweight-izing and a time, and low-power-ization. For that, the effect by the technique of lowering the power consumption of the display [itself] other than highly-efficient-izing of the dc-battery for power is large.
[0003] At a LCD, the luminous efficacy of the inverter for the fluorescence spool used as a backlighting, a light guide plate, and fluorescence spools is low, and since the effect by efficient-izing to the power with which the present condition is consumed with these lightings is large, there is almost no attempt of the power consumption reduction by enhancement of a display material or the display panel [itself]. However, it is thought required to reduce the power consumption of the display panel [itself] in the future.
[0004] It is thought that the power consumption of the display panel [itself] is mainly dependent on the drive technique of a driver-IC property and a display panel, and enhancement of low-battery-izing of a use driver IC is advanced. However, it is not easy to reduce the power consumption of a transistor which takes charge of each pixel drive of a driver IC by the technique (TFT-LCD) of preparing switching devices, such as TFT (TFT), in the display pixel section, and repeating a picture signal a short period and writing it in.
[0005] By TFT-LCD of a present 10 inch class, although a back light lighting is about [5W] about [1.5W], in order for the power consumption of a circuit system to long-time-ize a cell operation, as for own power consumption of a display panel, less than [1W] and less than [desirable / 0.2W] in which a drive by the small lightweight cell is possible are demanded. The problem of this power consumption becomes remarkable from the penetrated type display accompanied by a lighting with the reflected type display accompanied by a lighting. In the display of 50cm or more of the vertical angles especially used for the display for an advertisement etc., consumed electric power was producing the constraint of an installation.
[0006] Drawing 11 (a) is the circuit-arrangement view showing the conventional active matrix type LCD. TFT 77, a pixel section electrode, etc. of the scanning line 73, the signal line 74, the common wiring 75, and 3 terminal switching device are created by the thin film process, and a scanning signal and a picture signal are respectively inputted into the scanning line 73 and the signal line 74 from a driver IC according to it. Here, TFT 77 into which the scanning signal was inputted will be in an ON state, and it is transmitted to liquid crystal 79 while the picture signal from a signal line 74 is accumulated at the supplementary capacity 78. When a scanning signal is not inputted, since TFT 77

will be in an OFF state, the picture signal impressed at the time of ON is held as it is at liquid crystal 79.

[0007] It obtains with the signals to write in, and even if it is the same picture image, when [required] carrying out the alternating current drive of the liquid crystal material, it will be necessary to make TFT into an ON state by the scanning signal, and to re-write in a picture signal again, in such a LCD of structure. Therefore, since the driver IC for - picture signals for scanning signals which generates a driving signal operates continuously, power is always consumed.
[0008] On the other hand, as shown in drawing 11 (b), the method of operating the 2nd switching device T2 is proposed by holding an analog signal to a capacitive load C1 by the 1st switching device T1 (J. Vanfleteren (IDRC1988, p 74-79)). However, in order not to make the ******** data further held since the capacity load C2 connected with the switching device T2 and this became large as the size of a display pixel becomes large produce change, the switching device T1 with the capacity to drive the mass load capacity C1 is needed.
[0009] For example, elevation of the on resistance of T2 occurs by the threshold voltage whose capacity value of C1 on a design is a level decrement of the ON signal sent to T2 when T1 becomes off [from ON] to a parvus case, and the boundary voltage from which T2 will be in an ON state too much carrying out change with the passage of time, and the target display is not attained. In addition, large-sized-ization of C1 etc. will cause elevation of power consumption. The problem on these designs is because this element configuration consists of an analog-sample hold circuit, and it was asked for the display of a new configuration.
[0010] On the other hand, in the active matrix type LCD, the method of performing the digital gradation display by the area modulation is proposed. This changes the dimension of each pixel electrode within a block, and carries out adjustable [of the display pixel area of each block] in digital by choosing the pixel which should be displayed within each block while it blocks a pixel electrode for every predetermined number.
[0011] However, by the conventional drive technique, the level shift of the pixel potential which affects a display performance at the time of switching occurs by the parasitic capacitance which switching devices, such as TFT, have. It is difficult to determine this amount of level shifts by the partition ratio of the switching noise charge of a parasitic capacitance and pixel electrode capacitance, for the amounts of level shifts to differ for every pixel electrode, when the dimensions of a pixel electrode differ, and to make it harmless also by adjustment of counterelectrode potential. Therefore, area gradation was substantially impossible.
[0012]
[Object of the Invention] Thus, although the method of driving it using an analog-sample hold circuit for a reduction of the power consumption of a driver IC rather than carrying out the direct drive of the switching device for supplying a signal to display material layers, such as liquid crystal, by the scanning line was proposed conventionally, effect sufficient by this technique has not been attained.
[0013] Moreover, area gradation was substantially [difficult / it / for the level shift of the pixel potential by the switching noise charge to occur, for these amounts of level shifts to differ for every pixel electrode in the example which performs the digital gradation display by the area modulation, when the dimensions of a pixel electrode differ, and to make it harmless also by adjustment of counterelectrode potential / therefore] impossible.
[0014] this invention was made in consideration of the above-mentioned situation, and the place made into the purpose is to offer the active matrix type display which can reduce the power consumption of a driver IC.
[0015] Moreover, it is in other purposes of this invention offering the active matrix type display which could reduce the power consumption of a driver IC and enabled the digital gradation display by the area modulation.
[0016]
[The means for solving a technical problem] In order to solve the above-mentioned technical probrem, this invention has adopted the following configurations. Namely, this invention (claim 1) is set to the

active matrix type display which prepared the switching device in each pixel by which matrix arrangement was carried out. The pixel electrode arranged in the shape of a matrix on the 1st substrate, and two or more scanning lines arranged along with ** on the other hand on the 1st substrate, Two or more signal lines arranged in the orientation which crosses with the aforementioned scanning line on the 1st substrate, The static type memory device holding the binary status signal inputted from a signal line according to the scanning signal which has been arranged, respectively and was inputted into each intersection of the aforementioned scanning line and the aforementioned signal line from the scanning line, The switching device which turns between terminals on and off with the signal which it was prepared corresponding to these memory devices, respectively, and one terminal was connected to the aforementioned pixel electrode, was connected to the wiring whose other-end child gives a reference potential, and was held at the aforementioned memory device, Opposite arrangement is carried out with the 1st substrate, and it is characterized by coming to provide the display material layer prepared between the 2nd substrate in which the counterelectrode was prepared so that it might counter with the aforementioned pixel electrode, and the 1st and 2nd substrates.
[0017] Here, the following are raised as a desirable embodiment of this invention.
(1) A display material layer should be liquid crystal.
(2) The scanning line and the signal line should be arranged pixel inter-electrode.
(3) Impress an alternating current signal to either [at least] the wiring which gives a reference potential, or a counterelectrode.
(4) When scanning selection of the memory device connected to the same scanning line is carried out, let the alternating current signal impressed from a wiring or a counterelectrode be fixed potential.
(5) The memory device holding a binary status signal should be formed of non-volatile memory.
(6) The memory device and the switching device should be formed of TFT.
[0018] Moreover, this invention (claim 4) is set to the active matrix type display which prepared the switching device in each pixel by which matrix arrangement was carried out. The pixel electrode arranged in the shape of a matrix on a substrate, and two or more scanning lines arranged along with ** on the other hand on the aforementioned substrate, Two or more signal lines arranged in the orientation which crosses with the aforementioned scanning line on the aforementioned substrate, The memory device holding the status signal inputted from a signal line according to the scanning signal which has been arranged at each intersection of the aforementioned scanning line and the aforementioned signal line, and was inputted from the scanning line, Corresponding to these memory devices, it is prepared, respectively, and one terminal is connected to the aforementioned pixel electrode. It connects with the wiring whose other-end child gives a reference potential, and it comes to provide the switching device from which the resistance between terminals changes with the signals held at the aforementioned memory device, the aforementioned pixel electrode is blocked for every predetermined number, and it is characterized by the dimensions of the pixel electrode within this block differing, respectively.
(1) A display material layer should be liquid crystal.
(2) The scanning line and the signal line should be arranged pixel inter-electrode.
(3) A switching device should operate in the two status of turning on and off, and should be equipped with the drive circuit which drives two or more signal lines and scanning lines with the potential of two status, respectively.
(4) The memory device, the switching device, and the drive circuit should consist of the TFT formed on the same substrate.
(5) Use a memory device as an image memory of an application system.
[0019]
[Operation] It is not necessary to rewrite periodically until the information which should be displayed by the pixel changes to a degree, and according to this invention (claim 1), the status is maintained by the static type memory device prepared for every pixel. When the display information on a display pixel does not change, since rewriting of the information on a memory device is unnecessary, the power which becomes unnecessary to add a scanning signal and a picture signal periodically, and is consumed by the driver IC is reduced.

[0020] That is, although a great portion of power was conventionally consumed by the charge and discharge of a capacity load with equipment, even if a display image does not change like before in this invention, it is not necessary to impress the signal which the fixed period inverted to a signal line for an alternating current drive, and most power with which the drive circuit which drives a signal line is mostly consumed there for a idle state becomes so small that it can ignore. Although the power by which an only consumption is carried out becomes what is depended on an alternating current drive of a counterelectrode, this is the grade by which a flicker is not ****ed, for example, since the low frequency of 60Hz or less is enough, power consumption is conventionally reduced drastically [about 1/1000] from 1/100 of the driving method.
[0021] Moreover, since the static type is used as a memory device, the big switching device with the capacity to drive a mass load capacity and this is not needed, and it is effective in the reduction of power consumption also from this point. Furthermore, although it was difficult to extend the signal rewriting period to a pixel from the off property of a switching device, or a constraint of flicker **** in the former in the case of the LCD, it is enabled to extend the rewriting period of all display pixels, and 1-pixel rewriting time with the equipment of this invention.
[0022] Moreover, according to this invention (claim 4), a pixel electrode is blocked for every predetermined number, and when the dimensions of the pixel electrode within the block differ, respectively, the digital multi-gradation display by the area modulation becomes easy as 1 block. Although the level shift of the pixel potential by the switching noise charge occurred as mentioned above when it was going to carry out an area modulation display in this way by the conventional driving method, in this invention, the level shift by this switching noise charge disappears the first stage after a switching end through the leakage resistance of photoelectrical transducer material, such as liquid crystal. For this reason, a display performance is not affected and the digital multi-gradation display by the area modulation is possible.
[0023] Furthermore, since the 1-pixel display status of photoelectrical transducer material, such as liquid crystal, is in ON or two off status, also in the time of a halftone display, an angle of visibility is large and the very good display quality which display unevenness does not have, either is obtained.
[0024]
[Example] The LCD which created the example of this invention hereafter using the TFT formed at the thin film process adapting well-known semiconductor technique is explained as an example.
(Example 1) Drawing 1 shows the basic configuration of the active matrix type LCD concerning the 1st example of this invention, (a) is an element structure-section view and (b) is a circuit-arrangement view. The pixel electrode 2 is arranged in the shape of a matrix on the 1st substrate 1 which consists of glass etc., between the pixel electrodes 2, the scanning line 3 is arranged at a space longitudinal direction, and the signal line 4 is arranged in the vertical orientation. Moreover, the reference line 5 is arranged in parallel with the scanning line 3. The memory device 6 later mentioned to the intersection of the scanning line 3 and the signal line 4 is formed, and the switching device 7 is formed between the memory device 6 and the pixel electrode 2.
[0025] Opposite arrangement of the 2nd substrate 9 which carries out predetermined ****** on a substrate 1, and consists of glass etc. is carried out, and the counterelectrode 8 is formed in the opposite side of a substrate 9. And the liquid crystal layer 10 as a display material layer is enclosed between each substrate 1 and 9. In addition, as for a scanning-line driver and 14, 13 in drawing is [a signal-line driver and 15] reference-line drivers.
[0026] Drawing 2 (a) is the circuit diagram showing the 1 pixel section configuration of this example. The binary data-hold memory device 6 is connected to the intersection of the scanning line 3 formed in the shape of a matrix, and the signal line 4, and the output section which outputs the information currently held is prepared in this memory device 6. The control terminal of 3 terminal switching device 7 is connected to the output section. This switching device 7 controls the resistance between a reference line 5 and the pixel electrode 2, and is adjusting the bias status of the liquid crystal layer 10.
[0027] It can consider, the memory circuit, i.e., the static type memory device, of the type which carried out positive feedback, using a two step inverter as an example of the memory device in drawing 2 (a).

This circuit is not enough as the off property of a transistor, and it has in it the characteristic feature whose implementation is possible as an element for analog signals with the transistor element which cannot be used.
[0028] Concrete circuit arrangement are shown in drawing 2 (b). Since capacity C1 is unnecessary, the element 21 of drawing 2 corresponding to the element T1 of drawing 11 (b) as compared with aforementioned drawing 11 (b) may be small. Each element size of a switching device 21 and the inverter-circuit sections 22 and 23 can be designed by the same view as optimum number-of-stages ratio n of the inverter-circuit section. Specifically, when the ratio of the element size of elements 21, 22, 23, and 24 specifies by 1:n:n:n*n, n=1-100 and ******** n=2-10 are good design conditions.
[0029] The example of circuit arrangement of the 1 pixel section which used other memory devices for drawing 3 (a), (b), and drawing 4 (a) and (b) is shown. Drawing 3 (a), (b), and drawing 4 (a) and (b) show the example of a configuration from which the connection position of 3 terminal switching device is different, respectively. Since the element number which a display pixel constitutes from structure conventionally increases, although optical use luminous efficacy decreases in a penetrated type display device, since a memory device etc. can be formed in the bottom of a reflector, a fall of the optical use luminous efficacy by this display device is not produced by the reflected type LCD.
[0030] A drive wave serves as a line sequential drive like a drive of the conventional LCD like drawing 5 . A sequential-scanning pulse is impressed to the scanning line 3, and the signal which controls opening and closing of a switching device 7 is inputted into the memory device 6 synchronized with this through a signal line 4. On the other hand, an alternating current signal is inputted into a common electrode (counterelectrode 8). If the conditions of the ratio of the resistance of a liquid crystal material and the resistance of a switching device are satisfied as above-mentioned, a good display will be attained by above-mentioned circuit and drive.
[0031] If change of this equipment is lost to a display image like a static image on an ideal, the refreshment to a memory device 6 is unnecessary. However, like drawing 5 , by the drive by the simple square-wave input, since the liquid crystal potential by the side of a switch is fixed by one of the potential status of the high potential of an alternating current driving signal, or low potential when a switch changes from an ON state to an OFF state, a direct-current-voltage component will be applied to the liquid crystal section. Therefore, in order to improve a display performance, it will be necessary to prepare the refreshment term for a liquid crystal potential setup in case a switch changes to an OFF state.

[0032] As easiest technique, there is a method of preparing a blanking term between the alternating current signals of a common electrode like drawing 6 (a). In the device of a conventional type, since parallel connection of the capacity 78 which guarantees the potential fall by the liquid crystal 79 of drawing 11 (a) or the leakage current of a switching device 77 was carried out to liquid crystal capacity, it was not easy to shorten the write-in time of a signal. Like drawing 2 (b), it accepts and comes out, and for a certain reason, the time of refreshment is shorter than the scan time which is spent for the signal for gate opening and closing of a switching device 21 and which is looked at by the element of a conventional type, and can be managed with the element of this invention.
[0033] Moreover, like drawing 6 (b), not all pixels are refreshed continuously but it is also possible to divide the time of the line to refresh and to insert between the liquid crystal driving signals which are rectangle signals. Although it is desirable that the memory on [all] a line is refreshed as for the inserting method when it sees in fixed time, it is also possible to attach and refresh weight on the display line which is the fixed position of a scan line, and corresponds when the display screen changes (for example, when the amount of blink display is a fixed position).
[0034] In addition, in drawing 6 (b), Tg is refreshment pulse width, l is 1 time of the number of refreshment lines, and the number of times of refreshment for 1 screen rewriting is defined by the (number of gate lines) / l.
[0035] Thus, since according to this example the static type memory device 6 is formed for every pixel and it is made to drive a switching device 7 for the storage information on this element 6, when display information does not change, rewriting of the information on a memory device 7 is unnecessary for this

reason, the power which becomes unnecessary to add a scanning signal and a picture signal periodically, and is consumed by the driver IC is reduced sharply.
[0036] Moreover, since a memory device 6 is a static type, the big switching device T1 which has the capacity to drive the mass load capacity C1 and this, like before shown in aforementioned drawing 11 (b) is not needed, and it is effective in the reduction of power consumption also from this point. Furthermore, in this example, the off property of a switching device or a constraint of flicker **** is suppressed, and it is enabled to extend the rewriting period and the 1-pixel rewriting time which are all display pixels.
[0037] the status that the power consumption trial calculation by TFT-LCD of the 10 inch class which used the amorphous silicon thin film does not rewrite the display screen in this example -- 10mW and per second -- a stroke -- large low-power-ization of 1/50 was [less than 30mW and the former / as rewriting status of a field] realizable
(Example 2) Drawing 7 is for explaining the active matrix type LCD concerning the 2nd example of this invention, and the circuit diagram in which (a) shows a 1 pixel section configuration, and (b) are the structure-section views of a memory device.
[0038] Fundamentally, although this example is the same as that of the 1st example, as shown in drawing 7 (a), non-volatile memory rewritable as a memory device 30 is used for it. The concrete configuration of a memory device 30 is as being shown in drawing 7 (b), and makes the gate of usual reverse stagger type TFT two-layer structure. 31 in drawing -- a substrate and 32 -- for the 2nd gate (floating gate) and 35, a tunnel insulator layer and 36 are [the 1st gate (control gate) and 33 / a gate insulator layer and 34 / a protection insulator layer, and 38a and 38b of barrier layers, such as a-Si, and 37] source drain electrodes
[0039] The number of times of rewriting is 107 which is the standard of the number of times of switching of a drive conventionally. Although it is an ideal to satisfy the rewriting operation more than a time, if it is the display with which a still picture display serves as a subject, the number of times of rewriting can decrease 100 - 1/10000, and can be used as a memory device of this display. Although the above-mentioned memory device serves as EEPROM configuration, it can constitute the display with it. [same when the electric-field-dielectric constant curve (D-E curve) of dielectric materials consists of a material which has a property in a hysteresis]
[0040] Specifically, as shown in drawing 8 , a memory device is created by using the dielectric materials which have a hysteresis as a gate insulator layer, it is controlling the voltage between terminals applied to a memory device, and a reset of a memory device and the signal writing of memory are performed. As shown in drawing, in addition to the technique of connecting TFT 7 to a memory device, connection of a memory device is also possible by enhancement of a driving signal to the direct presentation electrode.
(Example 3) Although an alternating current signal is inputted only into Vcom (common electrode 8) and the liquid crystal material is driven in the 1st example, you may input an alternating current signal into Vref side (reference line 5). When an alternating current signal is inputted into Vref, change of the common electrode potential by the joint capacity of a reference line 5 and the common electrode 8 is observed through the liquid crystal layer 10. It is also possible for there to be a method of using the signal which reversed the sign of a driving signal every reference line 5, and to carry out the period of an alternating current driving signal for every scan time further as a cure of this change.
[0041] On the other hand, it is Vcom about an alternating current signal. Vref It inputs into both, and driving is also possible and low-battery-ization of the driver IC for driving signals of it is attained. This drive is Vcom. As compared with the case where an alternating current drive is carried out, the amount of currents which flows to one output terminal of a driver IC, or the voltage outputted becomes low, and it is enabled to lower the power which a driver IC consumes.
[0042] As a material which constitutes the barrier layer of the memory device in each example, although single crystal silicon, polycrystal silicon, and an amorphous silicon can be considered, if especially the display device of this structure is an element which can operate 3 terminal switching device, the ratio of the resistance at the time of opening and closing is 105. Although it is desirable that it is about [twice],

even if it is about 100 times at the lowest, it is thought that enforcement is possible. Use of the amorphous silicon by which this was ****ed less than [an organic material, the low temperature of about 150 degrees C, or it] in the barrier layer also comes to be considered, and the constraint on the process of each material and the constraint on element structure are eased.
[0043] Moreover, with the element which reduced the phot ******** fee process, even if it is the element of the switch property with the former inadequate as a display device, a still high contrast display is obtained. Moreover, a miniaturization of a size is realizable by carrying out enhancement of the element 24 in drawing 2 (b) in a performance by technique, such as various annealing. It is also possible to set it as the alternating current signal by the side of the long period by which a flicker is seldom ****ed (- 10 seconds) on the other hand, if an electro-optics-material property does not usually carry out a degradation with the passage of time in the use domain in the liquid crystal of a display material.
(Example 4) The technique refreshed for a memory device is making a weighting the line which change has generated in the display screen as above-mentioned, and it has realized stopping other power consumption for a still picture display. Although this drive technique can constitute a part for a mechanical component from enhancement of the conventional line sequential drive (the driving method which scans a scanning wiring sequentially), it is necessary to carry out the scan of the scanning wiring corresponding to the recognized animation fraction. Although it becomes low-power-ization to recognize an animation fraction correctly and to rewrite the signaling information of only the animation section from the effect of decreasing the number of scanning wirings simply, constituting of drive IC becomes complicated and elevation of power consumption will be caused on the contrary.
[0044] Then, a reduction of the power consumption of total drive IC can be aimed at by blocking the number of specification lines of the animation display section. the number of lines to block ****** -- 10-200 -- the number of scanning lines of 50-100 is desirably good The specification technique of the blocked line prepares an image memory in the input section of a picture signal, and outputs the block position and signal of the scan line section which detected and detected the animation fraction to drive IC. On the basis of this output, signal supply to the memory device corresponding to the animation display fraction is performed.
[0045] The power consumption of the memory to which having an image memory outside corresponds must be reduced compared with the power consumption of this display device. In an ideal, although it is necessary to have an image memory for every display pixel, an animation is simply detectable by performing the comparison with the pre-count data which have memorized the status signal of the same scan line, for example a fixed period or after sampling all one by one and counting a binary information.

[0046] Although it cannot recognize by this technique even if it is animation display when the total whose display pixel is an ON state is the same, in addition to above-mentioned technique, the decrement of the error of an animation recognition is sharply attained by the comparison which uses the sum of the blocked memory data of the scan line section. On the other hand, the count mistake generated in the thump ****** section and the counter section poses a problem by this counter formula. When there are many count mistakes, in order to recognize all to be an animation, the effect of this configuration circuit cannot be expected. Then, this problem is solvable by taking a count error into consideration beforehand at the time of a comparison.
[0047] How to make the weighting of a semipermanent display display as simplification technique is also considered in the configuration of the animation detecting element which acquires the information on an animation from an image memory and this memory information. Specifically, many of software of a personal computer etc. has the screen of the object for selection, or a functional display in many cases among the circumference section of the display screen. Many of screen display for this selection does not change in many cases. In such a case, since the field which does not have much animation display is beforehand known to typical software, it is enabled to lower the weighting of the refreshment of a scanning signal to the field.
[0048] When the viewing area with the high probability which is a still picture exists also about

individual software, it also becomes possible to carry out a weighting by an user specifying the field. The technique of operation screens, such as PDA, preparing for the display side beforehand the weighting for which a screen is refreshed partly about the device which can to some extent be predicted, and specifying with switches, such as DIP-SW, is also possible.

[0049] Moreover, also in operation screens, such as a measuring equipment, etc., the field where the display status of a screen changes frequently becomes main [the fraction of the menu which carries out the fraction which displays a measurement result, and operation guidance]. In addition, since these measuring instruments etc. understand beforehand that only a display of a measurement result changes when an user does not operate a control panel, they will scan the screen corresponding to the fraction of a measurement result display, and should just perform signal supply to a memory device.

[0050] Also in this case, it can correspond by setup by the side of display. What is necessary is just to arrange the screen of animation display so that an animation display fraction may concentrate on the scan line which specialization followed since the effect of this equipment will become high, if there are few lines scanned by animation display still finely.

(Example 5) Drawing 9 is the 1-block outline circuit-arrangement view of the active matrix type LCD concerning the 5th example of this invention.

[0051] Here, it is in the case of a 4 bit 16 gradation display. The block (i1-M, j1-N) of ij position when making the pixel block count of the whole display into MxN piece is shown. In a display of mainstream VGA specification, it is set to M= 640 and N= 480 with a personal computer now.

[0052] The AND gate Gij is formed in the intersection of address-line ADRS-Xi of the orientation of screen X, and address-line ADRS-Yi of the orientation of screen Y, and AND-gate G0ij - G3 ij are formed in each intersection of the output and four image data lines D0-D3. The output of AND-gate G0ij - G3 ij is connected to memory device M0ij-M3ij, it connects with the gate electrode of switching-transistor T0ij-T3ij, and the output of memory device M0ij-M3ij controls turning on and off of switching-transistor T0ij-T3ij. Another side is connected to 1st common potential line COM1 through the pixel electrode at liquid crystal P0ij-P3ij of a pixel for either the source of switching-transistor T0ij-T3ij, or the drain electrode.

[0053] In addition, not only a static type but a dynamic type which was used in the 1st example is sufficient as the memory device of this example, EEPROM is further sufficient as it and it can use various kinds of formulae.

[0054] If area of the pixel electrode corresponding to P0 is set to 1 as the area of a pixel electrode differs, respectively and is shown in drawing 10 , twice and P2 have increased 4 times and P3 has increased [P1] 8 times. The other end of liquid crystal P0ij-P3ij of a pixel is connected to 2nd common potential line COM2 which is a common electrode. Between 1st common potential line COM1 and 2nd common potential line COM2, the liquid crystal drive power DRV of an alternating current is connected.

[0055] An operation of this example is as follows. Both 4-bit image data continues holding the status until address-line ADRS-Yj of address-line ADRS-Xi of the orientation of screen X and the orientation of screen Y is memorized by active time memory device M0ij-M3ij and is next chosen again. Although fixed alternating voltage (for example, TN liquid crystal currently used for general present **5 voltage of 10V amplitude of V) required for a drive of the used liquid crystal is impressed to a counterelectrode It is controlled [by which the above-mentioned driver voltage is impressed to liquid crystal P0ij-P3ij of a pixel / or or] by switching-transistor T0ij-T3ij restricted by this memory circuit M0ij-M3ij prepared for every pixel whether impression is carried out, and the desired display status is maintained.

[0056] Although a great portion of power was consumed by the charge and discharge of the internal equivalent capacity of a data-line drive circuit or a control circuit, or a data-line wiring capacity load, the high-speed charge and discharge of counterelectrode capacity, etc. in the conventional active matrix LCD Even if a display image does not change like before, it is not necessary to impress the signal which the fixed period inverted to the data line for an alternating current drive, and in this example, most power with which a data-line drive circuit and a control circuit are mostly consumed there for a idle state becomes so small that it can ignore. Although the power by which an only consumption is carried out

becomes what is depended on a direct-current drive of a counterelectrode, this is the grade by which a flicker is not ****ed, for example, since the low frequency of 60Hz or less is enough, power consumption is conventionally reduced by 1/100 to about 1/1000 of the driving method.
[0057] This ground is explained below. Capacity Ccom of the whole counterelectrode It determines mostly by dielectric constant [of electrode area S and liquid crystal] epsilon, and gap d, and is set to Ccom =epsilonS/d, and, in the case of the LCD of a 10 inch class, the capacity is about 0.1-0.3 micro F. They are frequency fdrv and voltage Vdrv about this capacity. Power Pcom consumed by carrying out charge and discharge by alternating voltage Pcom =Ccom, fdrv, and Vdrv 2 It is given, and when it drives by 60Hz **5V, it is set very much to 0.15mW - 0.45mW to a parvus thing. In fact, although the power consumption by the leakage current in the leakage resistance and memory circuit of liquid crystal, or a drive circuit is added to it, the power consumption as whole is still stopped small about several 10mW from 1mW.
[0058] Furthermore, a pixel electrode is blocked for every predetermined number, and when the dimensions of the pixel electrode within the block differ, respectively, the digital multi-gradation display by the area modulation becomes easy as 1 block. The following problems when carrying out such an area modulation display by the conventional driving method do not occur, but very high-definition display quality is obtained.
[0059] Although the level shift of the pixel potential which affects a display performance at the time of switching occurred by the drive conventionally by the parasitic capacitance which switching devices, such as TFT, have, when this amount of level shifts is determined by the partition ratio of the switching noise charge of the above-mentioned parasitic capacitance and pixel electrode capacitance and the dimensions of a pixel electrode differed, the amount of level shifts was difficult to differ for every pixel electrode and to make it harmless also by adjustment of counterelectrode potential, and area gradation was substantially impossible.
[0060] In this example, since the level shift by this switching noise charge disappears the first stage after a switching end through the leakage resistance of liquid crystal, it does not affect a display performance and the digital multi-gradation display by the area modulation is possible for it. Moreover, by this technique, since it is in ON or two off status in the state of a 1-pixel display of liquid crystal, also in the time of a halftone display, an angle of visibility is large and the very good display quality which neither display unevenness nor a flicker also has is obtained.
[0061] In addition, this invention is not limited to each example mentioned above. In the example, although liquid crystal was used as a display material layer, not only this but other materials can be used. For example, applying to EL, a plasma display, etc. is possible. Moreover, in the case of liquid crystal, it is possible not only a reflected type but to apply to a penetrated type. In addition, in the domain which does not deviate from the summary of this invention, it can deform variously and can carry out.
[0062]
[Effect of the invention] Since the memory device of the static type for controlling a switching device for every pixel is provided according to this invention as explained in full detail above, the power which becomes unnecessary to add a scanning signal and a picture signal periodically, and is consumed by the driver IC can be reduced. Therefore, miniaturization of the power unit of a conventional type or time extension of a charged type power unit is enabled.
[0063] Moreover, since the memory device for controlling a switching device for every pixel is prepared in the formula which blocks for every pixel of a predetermined number and performs a gradation display according to this invention, it is enabled to be able to suppress the level shift by the switching noise charge, and to be able to reduce the power consumption of a driver IC, and to perform the digital gradation display by the area modulation.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] Especially this invention relates to the active matrix type display using switching devices, such as TFT, with respect to image display equipments, such as a liquid crystal display.

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PRIOR ART

[Prior art] In recent years, the development of the display of thin shapes, such as a liquid crystal display, is performed actively. Especially the demand to a display of portable [which can be carried anywhere], or a big screen is increasing, and it is asked for long-time-izing of lightweight-izing and a time, and low-power-ization. For that, the effect by the technique of lowering the power consumption of the display [itself] other than highly-efficient-izing of the dc-battery for power is large.
[0003] At a LCD, the luminous efficacy of the inverter for the fluorescence spool used as a backlighting, a light guide plate, and fluorescence spools is low, and since the effect by efficient-izing to the power with which the present condition is consumed with these lightings is large, there is almost no attempt of the power consumption reduction by enhancement of a display material or the display panel [itself]. However, it is thought required to reduce the power consumption of the display panel [itself] in the future.
[0004] It is thought that the power consumption of the display panel [itself] is mainly dependent on the drive technique of a driver-IC property and a display panel, and enhancement of low-battery-izing of a use driver IC is advanced. However, it is not easy to reduce the power consumption of a transistor which takes charge of each pixel drive of a driver IC by the technique (TFT-LCD) of preparing switching devices, such as TFT (TFT), in the display pixel section, and repeating a picture signal a short period and writing it in.
[0005] By TFT-LCD of a present 10 inch class, although a back light lighting is about [5W] about [1.5W], in order for the power consumption of a circuit system to long-time-ize a cell operation, as for own power consumption of a display panel, less than [1W] and less than [desirable / 0.2W] in which a drive by the small lightweight cell is possible are demanded. The problem of this power consumption becomes remarkable from the penetrated type display accompanied by a lighting with the reflected type display accompanied by a lighting. In the display of 50cm or more of the vertical angles especially used for the display for an advertisement etc., consumed electric power was producing the constraint of an installation.
[0006] Drawing 11 (a) is the circuit-arrangement view showing the conventional active matrix type LCD. TFT 77, a pixel section electrode, etc. of the scanning line 73, the signal line 74, the common wiring 75, and 3 terminal switching device are created by the thin film process, and a scanning signal and a picture signal are respectively inputted into the scanning line 73 and the signal line 74 from a driver IC according to it. Here, TFT 77 into which the scanning signal was inputted will be in an ON state, and it is transmitted to liquid crystal 79 while the picture signal from a signal line 74 is accumulated at the supplementary capacity 78. When a scanning signal is not inputted, since TFT 77 will be in an OFF state, the picture signal impressed at the time of ON is held as it is at liquid crystal 79.

[0007] It obtains with the signals to write in, and even if it is the same picture image, when [required] carrying out the alternating current drive of the liquid crystal material, it will be necessary to make TFT into an ON state by the scanning signal, and to re-write in a picture signal again, in such a LCD of structure. Therefore, since the driver IC for - picture signals for scanning signals which generates a

driving signal operates continuously, power is always consumed.
[0008] On the other hand, as shown in drawing 11 (b), the method of operating the 2nd switching device T2 is proposed by holding an analog signal to a capacitive load C1 by the 1st switching device T1 (J. Vanfleteren (IDRC1988, p 74-79)). However, in order not to make the ******** data further held since the capacity load C2 connected with the switching device T2 and this became large as the size of a display pixel becomes large produce change, the switching device T1 with the capacity to drive the mass load capacity C1 is needed.
[0009] For example, elevation of the on resistance of T2 occurs by the threshold voltage whose capacity value of C1 on a design is a level decrement of the ON signal sent to T2 when T1 becomes off [from ON] to a parvus case, and the boundary voltage from which T2 will be in an ON state too much carrying out change with the passage of time, and the target display is not attained. In addition, large-sized-ization of C1 etc. will cause elevation of power consumption. The problem on these designs is because this element configuration consists of an analog-sample hold circuit, and it was asked for the display of a new configuration.
[0010] On the other hand, in the active matrix type LCD, the method of performing the digital gradation display by the area modulation is proposed. This changes the dimension of each pixel electrode within a block, and carries out adjustable [of the display pixel area of each block] in digital by choosing the pixel which should be displayed within each block while it blocks a pixel electrode for every predetermined number.
[0011] However, by the conventional drive technique, the level shift of the pixel potential which affects a display performance at the time of switching occurs by the parasitic capacitance which switching devices, such as TFT, have. It is difficult to determine this amount of level shifts by the partition ratio of the switching noise charge of a parasitic capacitance and pixel electrode capacitance, for the amounts of level shifts to differ for every pixel electrode, when the dimensions of a pixel electrode differ, and to make it harmless also by adjustment of counterelectrode potential. Therefore, area gradation was substantially impossible.

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EFFECT OF THE INVENTION

[Effect of the invention] Since the memory device of the static type for controlling a switching device for every pixel is provided according to this invention as explained in full detail above, the power which becomes unnecessary to add a scanning signal and a picture signal periodically, and is consumed by the driver IC can be reduced. Therefore, miniaturization of the power unit of a conventional type or time extension of a charged type power unit is enabled.
[0063] Moreover, since the memory device for controlling a switching device for every pixel is prepared in the formula which blocks for every pixel of a predetermined number and performs a gradation display according to this invention, it is enabled to be able to suppress the level shift by the switching noise charge, and to be able to reduce the power consumption of a driver IC, and to perform the digital gradation display by the area modulation.

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TECHNICAL PROBLEM

[Object of the Invention] Thus, although the method of driving it using an analog-sample hold circuit for a reduction of the power consumption of a driver IC rather than carrying out the direct drive of the switching device for supplying a signal to display material layers, such as liquid crystal, by the scanning line was proposed conventionally, effect sufficient by this technique has not been attained.
[0013] Moreover, area gradation was substantially [difficult / it / for the level shift of the pixel potential by the switching noise charge to occur, for these amounts of level shifts to differ for every pixel electrode in the example which performs the digital gradation display by the area modulation, when the dimensions of a pixel electrode differ, and to make it harmless also by adjustment of counterelectrode potential / therefore] impossible.
[0014] this invention was made in consideration of the above-mentioned situation, and the place made into the purpose is to offer the active matrix type display which can reduce the power consumption of a driver IC.
[0015] Moreover, it is in other purposes of this invention offering the active matrix type display which could reduce the power consumption of a driver IC and enabled the digital gradation display by the area modulation.

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MEANS

[The means for solving a technical problem] In order to solve the above-mentioned technical probrem, this invention has adopted the following configurations. Namely, this invention (claim 1) is set to the active matrix type display which prepared the switching device in each pixel by which matrix arrangement was carried out. The pixel electrode arranged in the shape of a matrix on the 1st substrate, and two or more scanning lines arranged along with ** on the other hand on the 1st substrate, Two or more signal lines arranged in the orientation which crosses with the aforementioned scanning line on the 1st substrate, The static type memory device holding the binary status signal inputted from a signal line according to the scanning signal which has been arranged, respectively and was inputted into each intersection of the aforementioned scanning line and the aforementioned signal line from the scanning line, The switching device which turns between terminals on and off with the signal which it was prepared corresponding to these memory devices, respectively, and one terminal was connected to the aforementioned pixel electrode, was connected to the wiring whose other-end child gives a reference potential, and was held at the aforementioned memory device, Opposite arrangement is carried out with the 1st substrate, and it is characterized by coming to provide the display material layer prepared between the 2nd substrate in which the counterelectrode was prepared so that it might counter with the aforementioned pixel electrode, and the 1st and 2nd substrates.
[0017] Here, the following are raised as a desirable embodiment of this invention.
(1) A display material layer should be liquid crystal.
(2) The scanning line and the signal line should be arranged pixel inter-electrode.
(3) Impress an alternating current signal to either [at least] the wiring which gives a reference potential, or a counterelectrode.
(4) When scanning selection of the memory device connected to the same scanning line is carried out, let the alternating current signal impressed from a wiring or a counterelectrode be fixed potential.
(5) The memory device holding a binary status signal should be formed of non-volatile memory.
(6) The memory device and the switching device should be formed of TFT.
[0018] Moreover, this invention (claim 4) is set to the active matrix type display which prepared the switching device in each pixel by which matrix arrangement was carried out. The pixel electrode arranged in the shape of a matrix on a substrate, and two or more scanning lines arranged along with ** on the other hand on the aforementioned substrate, Two or more signal lines arranged in the orientation which crosses with the aforementioned scanning line on the aforementioned substrate, The memory device holding the status signal inputted from a signal line according to the scanning signal which has been arranged at each intersection of the aforementioned scanning line and the aforementioned signal line, and was inputted from the scanning line, Corresponding to these memory devices, it is prepared, respectively, and one terminal is connected to the aforementioned pixel electrode. It connects with the wiring whose other-end child gives a reference potential, and it comes to provide the switching device from which the resistance between terminals changes with the signals held at the aforementioned memory device, the aforementioned pixel electrode is blocked for every predetermined number, and it is characterized by the dimensions of the pixel electrode within this block differing, respectively.

(1) A display material layer should be liquid crystal.
(2) The scanning line and the signal line should be arranged pixel inter-electrode.
(3) A switching device should operate in the two status of turning on and off, and should be equipped with the drive circuit which drives two or more signal lines and scanning lines with the potential of two status, respectively.
(4) The memory device, the switching device, and the drive circuit should consist of the TFT formed on the same substrate.
(5) Use a memory device as an image memory of an application system.

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OPERATION

[Operation] It is not necessary to rewrite periodically until the information which should be displayed by the pixel changes to a degree, and according to this invention (claim 1), the status is maintained by the static type memory device prepared for every pixel. When the display information on a display pixel does not change, since rewriting of the information on a memory device is unnecessary, the power which becomes unnecessary to add a scanning signal and a picture signal periodically, and is consumed by the driver IC is reduced.
[0020] That is, although a great portion of power was conventionally consumed by the charge and discharge of a capacity load with equipment, even if a display image does not change like before in this invention, it is not necessary to impress the signal which the fixed period inverted to a signal line for an alternating current drive, and most power with which the drive circuit which drives a signal line is mostly consumed there for a idle state becomes so small that it can ignore. Although the power by which an only consumption is carried out becomes what is depended on an alternating current drive of a counterelectrode, this is the grade by which a flicker is not ****ed, for example, since the low frequency of 60Hz or less is enough, power consumption is conventionally reduced drastically [about 1/1000] from 1/100 of the driving method.
[0021] Moreover, since the static type is used as a memory device, the big switching device with the capacity to drive a mass load capacity and this is not needed, and it is effective in the reduction of power consumption also from this point. Furthermore, although it was difficult to extend the signal rewriting period to a pixel from the off property of a switching device, or a constraint of flicker **** in the former in the case of the LCD, it is enabled to extend the rewriting period of all display pixels, and 1-pixel rewriting time with the equipment of this invention.
[0022] Moreover, according to this invention (claim 4), a pixel electrode is blocked for every predetermined number, and when the dimensions of the pixel electrode within the block differ, respectively, the digital multi-gradation display by the area modulation becomes easy as 1 block. Although the level shift of the pixel potential by the switching noise charge occurred as mentioned above when it was going to carry out an area modulation display in this way by the conventional driving method, in this invention, the level shift by this switching noise charge disappears the first stage after a switching end through the leakage resistance of photoelectrical transducer material, such as liquid crystal. For this reason, a display performance is not affected and the digital multi-gradation display by the area modulation is possible.
[0023] Furthermore, since the 1-pixel display status of photoelectrical transducer material, such as liquid crystal, is in ON or two off status, also in the time of a halftone display, an angle of visibility is large and the very good display quality which display unevenness does not have, either is obtained.

[Translation done.]

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EXAMPLE

[Example] The LCD which created the example of this invention hereafter using the TFT formed at the thin film process adapting well-known semiconductor technique is explained as an example.
(Example 1) Drawing 1 shows the basic configuration of the active matrix type LCD concerning the 1st example of this invention, (a) is an element structure-section view and (b) is a circuit-arrangement view. The pixel electrode 2 is arranged in the shape of a matrix on the 1st substrate 1 which consists of glass etc., between the pixel electrodes 2, the scanning line 3 is arranged at a space longitudinal direction, and the signal line 4 is arranged in the vertical orientation. Moreover, the reference line 5 is arranged in parallel with the scanning line 3. The memory device 6 later mentioned to the intersection of the scanning line 3 and the signal line 4 is formed, and the switching device 7 is formed between the memory device 6 and the pixel electrode 2.
[0025] Opposite arrangement of the 2nd substrate 9 which carries out predetermined ****** on a substrate 1, and consists of glass etc. is carried out, and the counterelectrode 8 is formed in the opposite side of a substrate 9. And the liquid crystal layer 10 as a display material layer is enclosed between each substrate 1 and 9. In addition, as for a scanning-line driver and 14, 13 in drawing is [a signal-line driver and 15] reference-line drivers.
[0026] Drawing 2 (a) is the circuit diagram showing the 1 pixel section configuration of this example. The binary data-hold memory device 6 is connected to the intersection of the scanning line 3 formed in the shape of a matrix, and the signal line 4, and the output section which outputs the information currently held is prepared in this memory device 6. The control terminal of 3 terminal switching device 7 is connected to the output section. This switching device 7 controls the resistance between a reference line 5 and the pixel electrode 2, and is adjusting the bias status of the liquid crystal layer 10.
[0027] It can consider, the memory circuit, i.e., the static type memory device, of the type which carried out positive feedback, using a two step inverter as an example of the memory device in drawing 2 (a). This circuit is not enough as the off property of a transistor, and it has in it the characteristic feature whose implementation is possible as an element for analog signals with the transistor element which cannot be used.
[0028] Concrete circuit arrangement are shown in drawing 2 (b). Since capacity C1 is unnecessary, the element 21 of drawing 2 corresponding to the element T1 of drawing 11 (b) as compared with aforementioned drawing 11 (b) may be small. Each element size of a switching device 21 and the inverter-circuit sections 22 and 23 can be designed by the same view as optimum number-of-stages ratio n of the inverter-circuit section. Specifically, when the ratio of the element size of elements 21, 22, 23, and 24 specifies by 1:n:n:n*n, n=1-100 and ******** n=2-10 are good design conditions.
[0029] The example of circuit arrangement of the 1 pixel section which used other memory devices for drawing 3 (a), (b), and drawing 4 (a) and (b) is shown. Drawing 3 (a), (b), and drawing 4 (a) and (b) show the example of a configuration from which the connection position of 3 terminal switching device is different, respectively. Since the element number which a display pixel constitutes from structure conventionally increases, although optical use luminous efficacy decreases in a penetrated type display device, since a memory device etc. can be formed in the bottom of a reflector, a fall of the optical use

luminous efficacy by this display device is not produced by the reflected type LCD.
[0030] A drive wave serves as a line sequential drive like a drive of the conventional LCD like drawing 5 . A sequential-scanning pulse is impressed to the scanning line 3, and the signal which controls opening and closing of a switching device 7 is inputted into the memory device 6 synchronized with this through a signal line 4. On the other hand, an alternating current signal is inputted into a common electrode (counterelectrode 8). If the conditions of the ratio of the resistance of a liquid crystal material and the resistance of a switching device are satisfied as above-mentioned, a good display will be attained by above-mentioned circuit and drive.
[0031] If change of this equipment is lost to a display image like a static image on an ideal, the refreshment to a memory device 6 is unnecessary. However, like drawing 5 , by the drive by the simple square-wave input, since the liquid crystal potential by the side of a switch is fixed by one of the potential status of the high potential of an alternating current driving signal, or low potential when a switch changes from an ON state to an OFF state, a direct-current-voltage component will be applied to the liquid crystal section. Therefore, in order to improve a display performance, it will be necessary to prepare the refreshment term for a liquid crystal potential setup in case a switch changes to an OFF state.

[0032] As easiest technique, there is a method of preparing a blanking term between the alternating current signals of a common electrode like drawing 6 (a). In the device of a conventional type, since parallel connection of the capacity 78 which guarantees the potential fall by the liquid crystal 79 of drawing 11 (a) or the leakage current of a switching device 77 was carried out to liquid crystal capacity, it was not easy to shorten the write-in time of a signal. Like drawing 2 (b), it accepts and comes out, and for a certain reason, the time of refreshment is shorter than the scan time which is spent for the signal for gate opening and closing of a switching device 21 and which is looked at by the element of a conventional type, and can be managed with the element of this invention.
[0033] Moreover, like drawing 6 (b), not all pixels are refreshed continuously but it is also possible to divide the time of the line to refresh and to insert between the liquid crystal driving signals which are rectangle signals. Although it is desirable that the memory on [all] a line is refreshed as for the inserting method when it sees in fixed time, it is also possible to attach and refresh weight on the display line which is the fixed position of a scan line, and corresponds when the display screen changes (for example, when the amount of blink display is a fixed position).
[0034] In addition, in drawing 6 (b), Tg is refreshment pulse width, l is 1 time of the number of refreshment lines, and the number of times of refreshment for 1 screen rewriting is defined by the (number of gate lines) / l.
[0035] Thus, since according to this example the static type memory device 6 is formed for every pixel and it is made to drive a switching device 7 for the storage information on this element 6, when a display information does not change, rewriting of the information on a memory device 7 is unnecessary. For this reason, the power which becomes unnecessary to add a scanning signal and a picture signal periodically, and is consumed by the driver IC is reduced sharply.
[0036] Moreover, since a memory device 6 is a static type, the big switching device T1 which has the capacity to drive the mass load capacity C1 and this, like before shown in aforementioned drawing 11 (b) is not needed, and it is effective in the reduction of power consumption also from this point. Furthermore, in this example, the off property of a switching device or a constraint of flicker **** is suppressed, and it is enabled to extend the rewriting period and the 1-pixel rewriting time which are all display pixels.
[0037] the status that the power consumption trial calculation by TFT-LCD of the 10 inch class which used the amorphous silicon thin film does not rewrite the display screen in this example -- 10mW and per second -- a stroke -- large low-power-ization of 1/50 was [less than 30mW and the former / as rewriting status of a field] realizable
(Example 2) Drawing 7 is for explaining the active matrix type LCD concerning the 2nd example of this invention, and the circuit diagram in which (a) shows a 1 pixel section configuration, and (b) are the structure-section views of a memory device.

[0038] Fundamentally, although this example is the same as that of the 1st example, as shown in drawing 7 (a), non-volatile memory rewritable as a memory device 30 is used for it. The concrete configuration of a memory device 30 is as being shown in drawing 7 (b), and makes the gate of usual reverse stagger type TFT two-layer structure. 31 in drawing -- a substrate and 32 -- for the 2nd gate (floating gate) and 35, a tunnel insulator layer and 36 are [the 1st gate (control gate) and 33 / a gate insulator layer and 34 / a protection insulator layer, and 38a and 38b of barrier layers, such as a-Si, and 37] source drain electrodes

[0039] The number of times of rewriting is 107 which is the standard of the number of times of switching of a drive conventionally. Although it is an ideal to satisfy the rewriting operation more than a time, if it is the display with which a still picture display serves as a subject, the number of times of rewriting can decrease 100 - 1/10000, and can be used as a memory device of this display. Although the above-mentioned memory device serves as EEPROM configuration, it can constitute the display with it. [same when the electric-field-dielectric constant curve (D-E curve) of dielectric materials consists of a material which has a property in a hysteresis]

[0040] Specifically, as shown in drawing 8 , a memory device is created by using the dielectric materials which have a hysteresis as a gate insulator layer, it is controlling the voltage between terminals applied to a memory device, and a reset of a memory device and the signal writing of memory are performed. As shown in drawing, in addition to the technique of connecting TFT 7 to a memory device, connection of a memory device is also possible by enhancement of a driving signal to the direct presentation electrode.

(Example 3) Although an alternating current signal is inputted only into Vcom (common electrode 8) and the liquid crystal material is driven in the 1st example, you may input an alternating current signal into Vref side (reference line 5). When an alternating current signal is inputted into Vref, change of the common electrode potential by the joint capacity of a reference line 5 and the common electrode 8 is observed through the liquid crystal layer 10. It is also possible for there to be a method of using the signal which reversed the sign of a driving signal every reference line 5, and to carry out the period of an alternating current driving signal for every scan time further as a cure of this change.

[0041] On the other hand, it is Vcom about an alternating current signal. Vref It inputs into both, and driving is also possible and low-battery-ization of the driver IC for driving signals of it is attained. This drive is Vcom. As compared with the case where an alternating current drive is carried out, the amount of currents which flows to one output terminal of a driver IC, or the voltage outputted becomes low, and it is enabled to lower the power which a driver IC consumes.

[0042] As a material which constitutes the barrier layer of the memory device in each example, although single crystal silicon, polycrystal silicon, and an amorphous silicon can be considered, if especially the display device of this structure is an element which can operate 3 terminal switching device, the ratio of the resistance at the time of opening and closing is 105. Although it is desirable that it is about [twice], even if it is about 100 times at the lowest, it is thought that enforcement is possible. Use of the amorphous silicon by which this was ****ed less than [an organic material, the low temperature of about 150 degrees C, or it] in the barrier layer also comes to be considered, and the constraint on the process of each material and the constraint on element structure are eased.

[0043] Moreover, with the element which reduced the phot ******** fee process, even if it is the element of the switch property with the former inadequate as a display device, a still high contrast display is obtained. Moreover, a miniaturization of a size is realizable by carrying out enhancement of the element 24 in drawing 2 (b) in a performance by technique, such as various annealing. It is also possible to set it as the alternating current signal by the side of the long period by which a flicker is seldom ****ed (- 10 seconds) on the other hand, if an electro-optics-material property does not usually carry out a degradation with the passage of time in the use domain in the liquid crystal of a display material.

(Example 4) The technique refreshed for a memory device is making a weighting the line which change has generated in the display screen as above-mentioned, and it has realized stopping other power consumption for a still picture display. Although this drive technique can constitute a part for a

mechanical component from enhancement of the conventional line sequential drive (the driving method which scans a scanning wiring sequentially), it is necessary to carry out the scan of the scanning wiring corresponding to the recognized animation fraction. Although it becomes low-power-ization to recognize an animation fraction correctly and to rewrite the signaling information of only the animation section from the effect of decreasing the number of scanning wirings simply, constituting of drive IC becomes complicated and elevation of power consumption will be caused on the contrary.
[0044] Then, a reduction of the power consumption of total drive IC can be aimed at by blocking the number of specification lines of the animation display section. the number of lines to block ****** -- 10-200 -- the number of scanning lines of 50-100 is desirably good The specification technique of the blocked line prepares an image memory in the input section of a picture signal, and outputs the block position and signal of the scan line section which detected and detected the animation fraction to drive IC. On the basis of this output, signal supply to the memory device corresponding to the animation display fraction is performed.
[0045] The power consumption of the memory to which having an image memory outside corresponds must be reduced compared with the power consumption of this display device. In an ideal, although it is necessary to have an image memory for every display pixel, an animation is simply detectable by performing the comparison with the pre-count data which have memorized the status signal of the same scan line, for example a fixed period or after sampling all one by one and counting a binary information.

[0046] Although it cannot recognize by this technique even if it is animation display when the total whose display pixel is an ON state is the same, in addition to above-mentioned technique, the decrement of the error of an animation recognition is sharply attained by the comparison which uses the sum of the blocked memory data of the scan line section. On the other hand, the count mistake generated in the thump ****** section and the counter section poses a problem by this counter formula. When there are many count mistakes, in order to recognize all to be an animation, the effect of this configuration circuit cannot be expected. Then, this problem is solvable by taking a count error into consideration beforehand at the time of a comparison.
[0047] How to make the weighting of a semipermanent display display as simplification technique is also considered in the configuration of the animation detecting element which acquires the information on an animation from an image memory and this memory information. Specifically, many of software of a personal computer etc. has the screen of the object for selection, or a functional display in many cases among the circumference section of the display screen. Many of screen display for this selection does not change in many cases. In such a case, since the field which does not have much animation display is beforehand known to typical software, it is enabled to lower the weighting of the refreshment of a scanning signal to the field.
[0048] When the viewing area with the high probability which is a still picture exists also about individual software, it also becomes possible to carry out a weighting by an user specifying the field. The technique of operation screens, such as PDA, preparing for the display side beforehand the weighting for which a screen is refreshed partly about the device which can to some extent be predicted, and specifying with switches, such as DIP-SW, is also possible.
[0049] Moreover, also in operation screens, such as a measuring equipment, etc., the field where the display status of a screen changes frequently becomes main [the fraction of the menu which carries out the fraction which displays a measurement result, and operation guidance]. In addition, since these measuring instruments etc. understand beforehand that only a display of a measurement result changes when an user does not operate a control panel, they will scan the screen corresponding to the fraction of a measurement result display, and should just perform signal supply to a memory device.
[0050] Also in this case, it can correspond by setup by the side of display. What is necessary is just to arrange the screen of animation display so that an animation display fraction may concentrate on the scan line which specialization followed since the effect of this equipment will become high, if there are few lines scanned by animation display still finely.
(Example 5) Drawing 9 is the 1-block outline circuit-arrangement view of the active matrix type LCD

concerning the 5th example of this invention.
[0051] Here, it is in the case of a 4 bit 16 gradation display. The block (i1-M, j1-N) of ij position when making the pixel block count of the whole display into MxN piece is shown. In a display of mainstream VGA specification, it is set to M= 640 and N= 480 with a personal computer now.
[0052] The AND gate Gij is formed in the intersection of address-line ADRS-Xi of the orientation of screen X, and address-line ADRS-Yi of the orientation of screen Y, and AND-gate G0ij - G3 ij are formed in each intersection of the output and four image data lines D0-D3. The output of AND-gate G0ij - G3 ij is connected to memory device M0ij-M3ij, it connects with the gate electrode of switching-transistor T0ij-T3ij, and the output of memory device M0ij-M3ij controls turning on and off of switching-transistor T0ij-T3ij. Another side is connected to 1st common potential line COM1 through the pixel electrode at liquid crystal P0ij-P3ij of a pixel for either the source of switching-transistor T0ij-T3ij, or the drain electrode.
[0053] In addition, not only a static type but a dynamic type which was used in the 1st example is sufficient as the memory device of this example, EEPROM is further sufficient as it and it can use various kinds of formulae.
[0054] If area of the pixel electrode corresponding to P0 is set to 1 as the area of a pixel electrode differs, respectively and is shown in drawing 10 , twice and P2 have increased 4 times and P3 has increased [P1] 8 times. The other end of liquid crystal P0ij-P3ij of a pixel is connected to 2nd common potential line COM2 which is a common electrode. Between 1st common potential line COM1 and 2nd common potential line COM2, the liquid crystal drive power DRV of an alternating current is connected.
[0055] An operation of this example is as follows. Both 4-bit image data continues holding the status until address-line ADRS-Yj of address-line ADRS-Xi of the orientation of screen X and the orientation of screen Y is memorized by active time memory device M0ij-M3ij and is next chosen again. Although fixed alternating voltage (for example, TN liquid crystal currently used for general present **5 voltage of 10V amplitude of V) required for a drive of the used liquid crystal is impressed to a counterelectrode It is controlled [by which the above-mentioned driver voltage is impressed to liquid crystal P0ij-P3ij of a pixel / or or] by switching-transistor T0ij-T3ij restricted by this memory circuit M0ij-M3ij prepared for every pixel whether impression is carried out, and the desired display status is maintained.
[0056] Although a great portion of power was consumed by the charge and discharge of the internal equivalent capacity of a data-line drive circuit or a control circuit, or a data-line wiring capacity load, the high-speed charge and discharge of counterelectrode capacity, etc. in the conventional active matrix LCD Even if a display image does not change like before, it is not necessary to impress the signal which the fixed period inverted to the data line for an alternating current drive, and in this example, most power with which a data-line drive circuit and a control circuit are mostly consumed there for a idle state becomes so small that it can ignore. Although the power by which an only consumption is carried out becomes what is depended on a direct-current drive of a counterelectrode, this is the grade by which a flicker is not ****ed, for example, since the low frequency of 60Hz or less is enough, power consumption is conventionally reduced by 1/100 to about 1/1000 of the driving method.
[0057] This ground is explained below. Capacity Ccom of the whole counterelectrode It determines mostly by dielectric constant [of electrode area S and liquid crystal] epsilon, and gap d, and is set to Ccom =epsilonS/d, and, in the case of the LCD of a 10 inch class, the capacity is about 0.1-0.3 micro F. They are frequency fdrv and voltage Vdrv about this capacity. Power Pcom consumed by carrying out charge and discharge by alternating voltage Pcom =Ccom, fdrv, and Vdrv 2 It is given, and when it drives by 60Hz **5V, it is set very much to 0.15mW - 0.45mW to a parvus thing. In fact, although the power consumption by the leakage current in the leakage resistance and memory circuit of liquid crystal, or a drive circuit is added to it, the power consumption as whole is still stopped small about several 10mW from 1mW.
[0058] Furthermore, a pixel electrode is blocked for every predetermined number, and when the dimensions of the pixel electrode within the block differ, respectively, the digital multi-gradation display by the area modulation becomes easy as 1 block. The following problems when carrying out such an

area modulation display by the conventional driving method do not occur, but very high-definition display quality is obtained.

[0059] Although the level shift of the pixel potential which affects a display performance at the time of switching occurred by the drive conventionally by the parasitic capacitance which switching devices, such as TFT, have, when this amount of level shifts is determined by the partition ratio of the switching noise charge of the above-mentioned parasitic capacitance and pixel electrode capacitance and the dimensions of a pixel electrode differed, the amount of level shifts was difficult to differ for every pixel electrode and to make it harmless also by adjustment of counterelectrode potential, and area gradation was substantially impossible.

[0060] In this example, since the level shift by this switching noise charge disappears the first stage after a switching end through the leakage resistance of liquid crystal, it does not affect a display performance and the digital multi-gradation display by the area modulation is possible for it. Moreover, by this technique, since it is in ON or two off status in the state of a 1-pixel display of liquid crystal, also in the time of a halftone display, an angle of visibility is large and the very good display quality which neither display unevenness nor a flicker also has is obtained.

[0061] In addition, this invention is not limited to each example mentioned above. In the example, although liquid crystal was used as a display material layer, not only this but other materials can be used. For example, applying to EL, a plasma display, etc. is possible. Moreover, in the case of liquid crystal, it is possible not only a reflected type but to apply to a penetrated type. In addition, in the domain which does not deviate from the summary of this invention, it can deform variously and can carry out.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[An easy explanation of a drawing]
[Drawing 1] The element structure-section view and circuit-arrangement view showing the basic configuration of the active matrix type LCD concerning the 1st example.
[Drawing 2] The circuit-arrangement view showing the 1 pixel section configuration of the 1st example.
[Drawing 3] The circuit-arrangement view showing the modification of the 1st example.
[Drawing 4] The circuit-arrangement view showing the modification of the 1st example.
[Drawing 5] Drawing showing an example of the driving signal in the 1st example.
[Drawing 6] Drawing showing other examples of the driving signal in the 1st example.
[Drawing 7] The circuit diagram and the structure-section view of a memory device showing the 1 pixel section configuration of the active matrix type LCD concerning the 2nd example.
[Drawing 8] Drawing showing an example of the driving signal in the 2nd example.
[Drawing 9] The 1-block outline circuit-arrangement view of the active matrix type LCD concerning the 5th example.
[Drawing 10] Drawing showing the size and the example of arrangement of a pixel in 1 block.
[Drawing 11] The circuit-arrangement view showing the conventional active matrix type LCD.
[An explanation of a sign]
1 -- The 1st substrate
2 -- Pixel electrode
3 -- Scanning line
4 -- Signal line
5 -- Reference line
6 -- Memory device
7 -- Switching device
8 -- Counterelectrode
9 -- The 2nd glass substrate
10 -- Liquid crystal layer (display material layer)
21 -- Switching device
22, 23 -- Inverter element
24 -- Switching device

[Translation done.]